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Vol. 93. JUNE 1, 1912. No. 22

Copper Refinery Stocks

In connection with the copper-refinery statistics, the amount of copper tied up in the electrolytic-refining process is a matter of interest. Regarding the copper so held in a multiple-system refinery of say, 10,000,000 lb. per month capacity, we believe the following figures are not far wrong:

In the tank room, exclusive of electrolyte, 9,750,000 lb. This includes starting-sheet stocks, half-eaten anodes, partly deposited cathodes, and all the miscellaneous copper which accumulates around the deposition tanks. The electrolyte would add about 250,000 lb. more. Around the anode furnaces, including stock of pig, the furnace bottoms, material for future blast-furnace treatment, etc., 1,300,000 lb. At the wirebar furnaces, including molds and bottoms, but excluding refined stock, about 1,230,000 lb. Various miscellaneous items, such as stocks in silver refinery, bluestone or nickel-salt departments, about 150,000 lb. The total copper thus figured would be about 12,680,000 pounds.

It is, of course, plain that the pig on hand for the anode furnaces and material on hand for blast-furnace treatment can be varied within any ranges whatever. In making the above estimates, we are simply attempting to figure on a safe working stock. So, in turn, it is possible to carry any stock of cathodes whatever, and as between pig and cathodes, the latter is the cheaper place to carry material that it is desired not to put into finished shapes. Here, again, we try to estimate only normal stocks.

As to the refined-copper stock of a 10,000,000-lb. plant, a stock of 1,000,000 lb. is practically no stock at all. It will be distributed among cakes, ingots, ingot bars and wirebars, and there are 57 varieties of the latter, so that practically it is the rare order that can be filled directly out of stock; consequently before the refined-copper stock begins to be comfortable, we may assume that an average 10,000,000-lb. refinery would carry a total copper stock of 13,680,000 pounds.

The present rated refinery capacity of the United States is about 1,494,000,000 lb. per annum. The actual electrolytic-copper production of the United States for 1911 was 1,156,000,000 lb., or 96,300,000 lb. per month. On the supposition that the refineries are at present working at the same rate, and making a small allowance for the fact that a series refinery should have a slightly smaller normal stock, in proportion to its capacity, we are of the impression that the refineries would, entirely exclusive of their refined stocks, have about 120,000,000 lb. of copper on hand.

As to how far this refinery stock can operate as a balance wheel is another interesting question. The ordinary refinery is kept fairly clean usually, but nothing compared to its condition just before a visit from the board of directors. The foremen of a refinery usually keep the large byproduct items cleaned up, but house-to-house canvass by the superintendent will commonly disclose a vast number of odd items, which will aggregate a large tonnage. Apart from this point, while receiving a regular 10,000,000-lb. input, a refinery can temporarily increase its output, and later hold the 10,000,000-lb. mark, by increased current density, thinner anodes and more frequent cathode pullings.

While this is at the expense of financial economy, we think it is not far from correct to state that the ordinary 10,000,000-lb. refinery could jump its output for two successive given months by at least 1,000,000 lb. per month, and after that hold its 10,000,000-lb. production at the disadvantage of higher cost, until the necessity for such a sprint were over, and normal running could be begun again.

At the same time, with cheap copper, it may pay to cast heavier anodes, put every tank into service and decrease the

current density, paying interest on copper and saving in working costs, and it is with a view to this, and to the statements we have made concerning accelerated production, and of normal metal stocks, that refinery statistics should be judged.

The American Iron and Steel Association

In his presidential address, at the meeting of the American Iron & Steel Institute last week, Judge Gary announced that arrangements were in progress by which the Institute would, at the close of the present year, take over the work of collecting and publishing the statistics of the iron and steel trades, which is now performed by the American Iron & Steel Association. This practically involves the dissolution of that association, or rather its merger in the Iron & Steel Institute, after an existence of 60 years.

Originally formed in 1855 for the purpose of working for tariff protection, it was not until 17 years later, when there was revival of interest, that the members saw and appreciated the advantages of collecting adequate statistics of the trade. This work was undertaken and extended so that in time the association became almost purely a statistical bureau. The organization was extended until it included almost every maker of iron and steel in the United States, and in recent years in Canada also. The gathering of statistics and their presentation were systematized in such a way that no other iron-making country possesses such complete records of its trade and production. In addition the association has issued from time to time carefully compiled directories of the trade, which constitute valuable books of reference.

The work has been thoroughly and admirably done and the credit for it is largely due to James M. Swank, who has been connected with the association for its 40 years, since the revival in 1872, at first as secretary and later with the title of general manager. In a large sense he has been the association and has commanded general respect by his wide knowledge of the trades and the thoroughness and excellence of his statistical work.

For some time past Mr. Swank has wished to retire on account of his advancing age and the condition of his health; and it was largely this fact that led to the proposed merger. He will carry into his retirement the universal wish that he may long enjoy his leisure. It is to be hoped that the Iron and Steel Institute will carry on the work on the lines laid down by Mr. Swank in his many years of successful labor.

On Technical Education

It is undeniable, we think, that a common defect in the courses of instruction in the engineering and technical schools of this country is the failure to give more attention to the subjects of general cultivation. We understand, of course, that such emphasis is put upon the scientific, technical and professional subjects that but little time remains for anything else. This is, we think, a mistake. It is not sufficient to urge in excuse that the general education that is needed ought to be accomplished in the high schools and academies. Granting that it ought to be, the fact is that it is not. Nor is it very useful to urge that students ought to take a regular colle giate course and finish with two, three or four years at the technical schools. There are relatively few young men who are able to enter upon and complete such a course of training. The conclusion is, we think, that the technical schools themselves ought to give more attention to the subjects of broad education; that they have not done so is doubtless their failure to recognize generally the practical importance of so doing.

In our own experience with many graduates, young and old, we find a general weakness in composition and in the use of the English language, and even more general inability to read the most important foreign languages, let us say French and German; a lack of acquaintance with the simplest features of business law and a dense ignorance of the principles of economics. Yet these are all matters of great importance to the engineer.

On the ability to write good English, W. L. Saunders, president of the Ingersoll-Rand Drill Co., himself a distinguished engineer as well as the head of a great manufacturing and business enterprise, in an address at the 38th annual commencement of the Colorado School of Mines at Golden, Colo., May 24, made the following emphatic remarks:

> But of greater importance than good speech and reading, of higher value to the engineer than manners, is ability to write good English. Engineers are not given to public speaking; they pride themselves in being workers; they compare themselves with General Grant, who did things. It is very true that the engineering profession is one of practical work; but no one can hope to achieve prominence in this profession who cannot write good, understandable English. An engineer may not talk, but he must make reports; he must write letters; he should draw specifications and plans. To do these things properly he must command and know how to use the tools of language. Lord Bacon tells us that "reading makes a full man, conversation a ready man, and writing an exact man." Engineering is an exact science; accuracy is the one column on which the whole structure is reared. To write clearly and accurately can hardly be called an accomplishment; it is really a necessity. No college course is complete, whether it be a classical, scientific, medical or law course, without a thorough training in English. No graduate is worthy to be called an educated man who does not speak and write good English. It lifts a man above the common; it makes him bigger than his business or profession; it trims the ship of knowledge, and puts oil on rough places; it makes the man.

In this connection it is interesting to refer to a new departure that we have previously reported, namely, that the Michigan College of Mines, which is always efficient and enterprising, has lately established a department of technical writing in which the first course of instruction will be given next year. Other technical schools have included in their curricula some training in the writing of abstracts, professional reports, etc., but we believe we are correct in our idea that no special emphasis has been put upon this work and that its performance on the part of the students has been rather perfunctory, without realization of its importance, simply because that has not been adequately brought to their attention.

The effort to encourage mining in South Australia by state loans has not been an unqualified success from a banking point of view. Of £55,237 loaned only £6111 has been returned.

By the Way

J. Parke Channing received a fee of $25,000 for his examination of the Calumet & Hecla and allied properties in connection with the consolidation plan in 1911.

Much manganiferous iron ore has been disclosed in some of the recent explorations in the Cuyuna iron district of Lake Superior. Already the enterprising promoter has capitalized these discoveries on the basis of the druggists' retail price for permanganate.

It is expected that the copper statistics for May will be another exhibition of how production may increase and yet not increase. This remark is not intended to be a reflection upon the refiners' reports, which we believe to be faithful and trustworthy, but merely a comment upon a mysterious condition which causes many to marvel.

A Joplin engineer, in a report on an Arkansas zinc property, developed by tunnels driven on the ore beds outcropping on the steep hillsides, advised that the tunnels be abandoned as "it is always cheaper and more satisfactory to operate from shafts." Evidently the "engineer" in this case was influenced in his generalization by the local practice of the shaft-perforated region about Joplin.

A special dispatch to the Boston *News Bureau* reads as follows: President Sun Yat Sen, of China, to his premier: "Go thou to our learned men and find the reason for this trembling of the earth beneath our feet. If it is an earthquake, I wish to know, so that I may save my august life." Premier, returning hotfoot: "Your Excellency, 'tis the Old Colony drill looking for the Mayflower lode."

A recent meeting of two operators in the Lake Superior iron region brought out an interesting refinement of terms. "What kind of developed ore do you refer to?" said the one. "In my state they speak of three different kinds, 'developed ore for the assessor,' 'developed ore for the operator' and 'developed ore for a prospective investor.'" We did not ask which kind usually showed the largest digits.

The plans for the new construction at the Old Dominion concentrator at Globe, Ariz., are being drawn by H. Kenyon Burch, and not by Mr. Caetani as mentioned in an item under "New Construction" in the JOURNAL of May 18. Mr. Burch has been connected with much important construction work in the Southwest, having designed among others the Miami mill and the new concentrator of the Moctezuma Copper Co., at Nacozari.

Engineering News relates an early example of efficiency engineering in the building of a large banking house in Philadelphia 40 years ago. The rate of hod-carrying up ladders for three stories was raised to a maximum in this way: A negro with a good sound heart, a first-class pair of lungs and a stout pair of legs was found. The darky was paid $5 a day at a time when the other hod-carriers got $2.50. But the condition on which he worked was that he should lead the line up the ladder and break the record. The rest of the line in that day were Irishmen. Therefore, they hated a darky and on general principles asserted the superiority of the white man. They had to be consistent to their assertions and principles.

We are forced to call for help over the following from one of our contemporaries: "Every chemist in general will agree that up to the present our methods of gravimetric and volumetric analysis are apt to have some phase where the accuracy is in doubt, where the reaction is not fully, or in some cases purely hypothetical, and therefore not absolutely correct; we therefore go through journals and chemical literature to find our way out of a labyrinth of reactions which take place by a simple precipitation of two bodies chemically acted upon according to the laws which govern these reactions, visible and obscure, to all our scientific endeavors, methods, instruments, ability and chemical reasoning." After which we are told that "the problem of the absolute precipitation of the sulphuric acid with barium salts is still problematic." Some problems are.

In 1910, the Government began suit against the Southern Pacific company for the recovery of 6000 acres of oil land in the Elk Hills section of Kern County, California. In a public statement on May 28, Attorney General Wickersham declares that the evidence now at hand presents "sensational and startling disclosures indicating a conspiracy among high officials of the Southern Pacific company to acquire under an agricultural grant oil lands valued at $15,000,000." The Government lawyers are confident that the disclosures of Charles W. Eberlein, a former land agent of the Southern Pacific, will result in the restoration to the public domain of this land, Eberlein having saved from the San Francisco fire secret correspondence and documents which are expected "to prove previous knowledge on the part of the railroad officials of the mineral character of the land selected, and an intention to keep the fact from the Government officials until after the patents should be secured."

When labor is abundant, operating officials can select new employees with an eye to upbuilding the efficiency of the force. Where wages and conditions of labor are attractive, as, for example, at Anaconda, "rustlers" are plentiful and the general efficiency of the labor is high. During the pleasant summer months, it is difficult at Anaconda to secure even a "rustling" card—which gives the bearer permission to enter the plant to seek work—while at smelting plants farther south, "rustlers" during this period are almost as scarce as good 10c. cigars. The situation is often acute after holidays, especially when payday and "long change" are celebrated simultaneously. At such periods, a mere slip of a boy or an old man, in fact almost anyone short of "the halt and the blind" can "get on," and may even tantalize the foreman by inquiring what sort of work it is before accepting. The Bristol *Times* records an instance. The foreman at a large metallurgical works was short of laborers one morning, and as a last resort went to an old tramp, who was lying asleep beside one of the furnaces, and aroused him with the question:: "I say, my man, are you wanting work?" "What kind of work?" asked the tramp. "Can you do anything with a shovel?" "Yes," replied the tramp, rubbing his eyes. "I could fry a piece of ham on it."

After having grown musty with age, the Old Dominion-Bigelow case was burnished up again for headline use on May 27, when the U. S. Supreme Court affirmed the Massachusetts judgment against A. S. Bigelow in favor of the Old Dominion Copper Mining & Smelting Co. for the return of about $2,100,000, representing secret promotion profits and expenses of A. S. Bigelow and Leonard Lewisohn. Brushing off the mold that must now obscure the records of the original suit, it will be found that the first bill, filed in October, 1902, alleged that Messrs. Bigelow and Lewisohn, with the aid of a syndicate formed by them, bought the Old Dominion Co. of Baltimore for $1,000,000, receiving gratis certain outlying claims. The Old Dominion Copper Mining & Smelting Co. was then formed with a capital of $3,750,000, of which $2,000,000 was divided among the syndicate members *pro rata*, $500,000 in stock being taken by Messrs. Bigelow and Lewisohn for promotion fees and expenses. It was claimed that the expenses were afterward paid out of the new company's treasury and further that $750,000 in stock was given to Messrs. Bigelow and Lewisohn for their outlying claims. Suit brought against the Lewisohn estate in New York on the same facts as in the Massachusetts case was decided against the company and the decision affirmed by the U. S. Supreme Court. However, in Massachusetts, approaching Justice from another angle with an imposing array of able and alert attorneys, the lady who holds the scales concluded that the force of gravity was pulling stronger on the company's pan. The newspapers say that Mr. Bigelow will now sue the Lewisohn estate.

Calumet & Hecla

During 1911 the Calumet & Hecla company stamped 2,909,972 tons of rock which yielded 25.47 lb. of copper per ton, or 74,130,977 lb. of copper. Costs, excluding some interest adjustments, were 8.52c. per lb. of copper; selling price of copper 12.82c. Costs per ton of rock were (excluding construction) $1.84. Of these tonnages 1,924,480 tons of rock came from the Conglomerate lode, producing 58,469,399 lb. of copper (30.38 lb. copper per ton of rock), at a cost of 8.25c. per lb. of copper, or $2.07 per ton of rock.

On the Conglomerate lode there were 546 ft. of sinking done, 8613 ft. of drifting, and 201 ft. of crosscutting. The Calumet No. 4 shaft is down 7995 ft. on the incline; the Hecla No. 7, 7666 ft.; and the South Hecla Nos. 7 and 10, 7627 ft.

On the Osceola lode, shaft No. 13 is the deepest, 3232 ft. on the incline. There were 985,492 tons of Osceola lode rock stamped, which yielded 15,661,578 lb. of copper at a cost of 9.95c. per lb., or $1.34 per ton of rock. No work was done on the Kearsarge lode.

The recrushing plant treated 477,794 tons of coarse tailings from the Calumet mill. The tailings carried 12.66 lb. of copper per ton, of which 4.50 lb. was recovered, or 2,152,110 lb. of copper, at a cost, exclusive of smelting and selling, of 5.01c. per lb. New furnaces, with mechanical pouring devices, are being installed at the Calumet & Hecla Smelting Works.

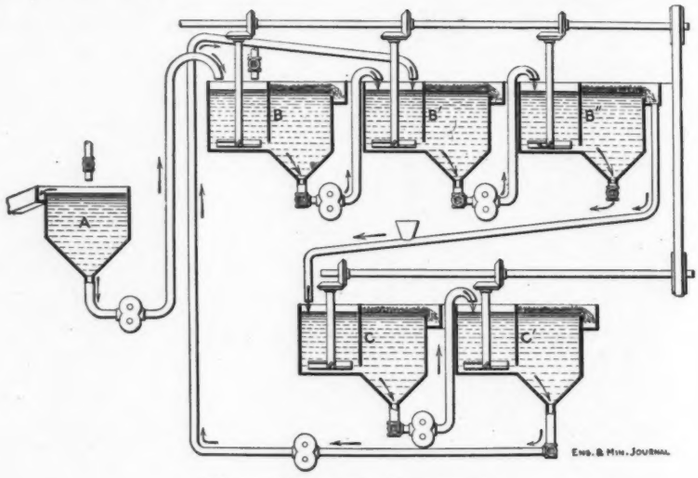
New South Wales Mining in 1911

The official reports for New South Wales for 1911 show the following mineral outputs, the items being arranged in descending order of value: Coal, 8,691,604 tons; silver-lead ore and concentrates, 338,469 tons; zinc, spelter and concentrates, 516,378 tons; gold, 181,121 fine oz.; copper ingots, matte, and ore, 12,100 tons; tin, ingots and ore, 1929 tons; pig lead, 17,276 tons; coke, 264,687 tons; silver, in ingots and mattes, 1,767,496 fine oz.; iron, 36,354 tons; precious opal, £57,300; oil shale, 75,104 tons; lime, 29,930 tons; wolfram ore, 283 tons; limestone flux, 46,237 tons; scheelite, 108 tons; all other items individually under £3800. The total value of the output was £9,758,000, an increase of £1,136,974 over 1910. Underground work in the Broken Hill Proprietary mine was resumed in February, 1911, after over a year's suspension. The same company commenced the production of spelter at its Port Pirie plant, but by far the greater part of its zinc, silver, and lead is shipped out of the state for treatment.

The Hyde Flotation Process

James M. Hyde, of Basin, Mont., has developed a flotation process for treating the ores of the Butte & Superior company. The experiments at Basin were so successful that the Butte & Superior company has erected a mill at Butte, on lines laid down by Mr. Hyde, details of which will be given below.

The description of the process is given in U. S. pat. No. 1,922,085, as follows: The ore, after crushing, is mixed with acid before thickening in a tank *A*. It has been found that adding the acid in advance cuts down the amount required, and promotes the settlement of colloidal material, which may be further aided, if necessary, by adding copperas, alum, or some other coagulant. From the thickener *A*, the pulp is pumped to the first treatment tank *B*, where oil is added and the entire mass agitated. A float concentrate is then taken off, and the gangue goes to the tank *B'*, where the process is repeated, and thence to *B''*, where the pulp is agitated and a third concentrate taken off. From *B''* the gangue is discharged as a final tailing.



HYDE FLOTATION APPARATUS

There is considerable silica mixed with the first concentrates, so they are all recleaned in a second device *CC'*, the concentrates from which are the final product, while the tailing is all sent back to *B'*.

As an example of actual work with this machine, the following description is given. The material treated was the slimy portion of an ore, consisting principally of quartz, blende and various amounts of decomposed granite, in which the feldspars were largely kaolinized. About 92% of this material was fine enough to pass a 150-mesh screen. Without the use of a coagulant, part of the slime, containing a notable percentage of zinc, would remain in suspension for over 24 hours.

The pulp, as produced, contained from 29 to 100 or more parts of water by weight to one part of ore, to which was added, before thickening, from one-quarter to one-half pound of sulphuric acid per ton of ore. The thickened pulp was heated in the flotation machine by live steam to expand the gas bubbles, and facilitate coating the sulphide particles with the oil used, which, in this case, was "candle-maker's red oil." The oil consumption cannot be calculated beforehand, but must be gaged by experience. The ore fed carried 23.3% of zinc; the concentrate, 51.4%, and the tailing, 3.2%, indicating a 91% recovery. The concentrates from the primary section of the machine ran 38 to 42% of zinc.

The Butte & Superior ore contains enough rhodochrosite to generate the carbon dioxide needed for its flotation. The ore has been treated for some time at the Basin reduction plant, rented from the United Copper Co. by the Butte & Superior Co. The mill was too small and the rental heavy, so plans were drawn for a 1000-ton mill, one 500-ton unit of which should be in operation by the end of May, the other about a month later. The installation consists of a crushing plant, jigs, hydraulic classifiers, a slime plant for oil flotation, and Wilfley tables, which are used only to separate the lead from the zinc. The ore is first reduced by rolls to six mesh, and, after jigging, the tailings are reground to 40 mesh, and the tailings from the fine jigs ground to 100 mesh and treated by oil flotation. The pulp is thickened to three parts water and one part ore, and is mixed with a small quantity of oil and sulphuric acid and agitated.

Within the Columbia River drainage basin, according to the Geological Survey, are at least one-third of the available water powers in the United States, but development of this resource has scarcely begun.

Correspondence and Discussion

Views, Suggestions and Experiences of Readers

Mining Codes

I would like to thank R. A. Burr for his admirable suggestion in the JOURNAL of Apr. 27, 1912, that all engineers using McNeill's code should state the edition on their letter heads and in their advertisements.

My original "Mining and General Code" first appeared in 1893—nearly 20 years ago. This period has shown marvellous progress in mining and metallurgy. To take one instance out of many: In 1893 the cyanide process was just becoming a practical success and the earlier code contains two sentences referring to it. The 1908 edition contains 65 sentences, under the headings: Cyanide; cyanide bullion; cyanide experiments; cyanide plant; cyanide process; cyanide treatment; cyanide vats; cyanided; cyaniding; cyaniding costs; as well as numerous other sentences, under the headings: Filter press; liquor; tanks; vats; zinc boxes; etc., etc.

The increase in the scale of the 1908 issue can be seen by the following comparison:

	1893 Code Contained	1908 Code Contains
Sentences and phrases	44,572	105,192
Mining surveys	644	1,278
Letters and cables, etc	944	13,200
Extra code	644	1,740
Numbers, weights, moneys, etc	4,648	18,820
Total cipher words	51,452	140,230

The result is a volume of about 1900 pages, well fitted for the office, but bulky for the traveling engineer. To meet this, the traveler's edition of the 1908 Code has recently been introduced as a small flexible volume, 6½x8¾ in., and only weighing 18 oz. It is an absolute photographic reproduction of the larger volume.

Your correspondent alludes to his difficulty in trying to decode a cable mesage by the wrong book. This cannot be done; the cipher words in the 1908 edition are different from those used in the original code. Each of the 140,230 cipher words was not only carefully selected for itself, but was also "eliminated" for telegraphic similarities, as against the cipher words of the earlier code, my aim being that either code could be used independently.

I cannot suppose that your correspondent complains at the issue of an uptodate code, but I would like to observe that the old code was getting behind the times and that I was approached from numerous quarters to issue a new one, in which should be incorporated all the economies the 1908 edition affords, together with the advantages of an additional 20 years' experience of the technical wants of the mining industry.

BEDFORD MCNEIL.

London, Eng., May 7, 1912.

The Tipuani, Bolivia, Rush

I have just received a letter from F. J. Dunleavey, Sorata, Bolivia, in which he tells of a stampede of American prospectors to the Tipuani valley in Bolivia, and asks me to do anything I can to help stop it. This stampede was started by a letter to a man named Jim McCormick in Ophir Creek, Alaska, written by a man who called himself Ferguson and telling of a rich placer strike in the Tipuani valley.

I spent two years in that district and prospected over the Tipuani valley from its head-waters in the Andes to where it joins the Mapiri. Mr. Dunleavey has been in that neighborhood for the last five years and is probably better acquainted with the existing conditions there than any other American. While there are undoubtedly some fairly rich placers in this valley, still everything has been filed on years ago and should any prospector make a strike there, he would immediately be overwhelmed with a mass of contests and it would be impossible for him to perfect his title or to take anything out. The trails leading to this valley, moreover, are among the worst in the world and unless a prospector went in very well equipped, he would find it impossible to even live there, let alone doing much prospecting. There is no such man as Ferguson in that district and no material amount of gold has been taken out of the Tipuani valley for many years.

If you can do anything in any way to aid in keeping prospectors away from this district, you will save them a very long journey and in all probability many hardships. Mr. Dunleavy is not only a man of the highest personal integrity, but is also an enthusiastic prospector, and would be the last man to discourage such a stampede if there were any chances that it might result in a strike of any importance. He is now and has been for the last five years, general manager of the Boston & Bolivia Rubber Co., which is operating on the Beni River. His address in Sorata, Bolivia.

JOHN W. HARRISON.

Kansas City, Mo., May 17, 1912.

As to Prospecting

UNITED STATES MINING LAWS

Title XXXII, Chap. 6, Revised Statutes.

Sec. 2318. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law."

Sec. 2319. All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens. . . .

Sec. 2320. Mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, . . . but no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located.

The tenor of many articles recently published in technical papers would lead both the prospective prospector and the prospective investor in prospects to the conclusion that there is no opportunity in these days for either, in the public lands of the west and particularly in the Forest Reserves. This is a mistaken conclusion and the statements make in Mr. Sheldon's article and many others which have appeared from time to time are utterly misleading, warranted neither by facts nor conditions. The reader might suspect a conspiracy to suppress prospecting.

Referring to the article in question, we will grant that there are fewer prospectors, relatively, than in earlier days. But there are other factors to be taken into consideration which have been noted in other articles which have appeared. It must, too, be remembered that with the discovery and development of the more easily discovered outcrops, the exhaustion of game, the necessity of some resource as a grub stake, and above all tireless and intelligent field work, prospecting is not what it used to be.

I must deny emphatically that there is anything in law or rulings that can drive the *bona fide* prospector from the forest reserves. The law is plain as stated above on this point and no rulings of the Department of Agriculture or the Land Office can drive the prospector from these legitimate fields for his activities. But the repetition of false assertions will influence some to desist prospecting.

It is true that the Forest Service has in many instances, filed complaint against application for patent on some mineral claims within the reserves and these are acted on by the special-agent service of

the General Land Office. There are, too, cases in which charges have been preferred, asking the General Land Office to oust certain prospectors from locations. These actions are made the basis of such broad assertions as appear from time to time, which are due either to ignorance of the facts or willful misrepresentation.

In this I know whereof I speak, having served in the Department of the Interior and examined in the field and by investigation, many of the cases against which charges had been preferred. It is admitted that there are cases in which charges have not been warranted. These are easily disposed of and generally without other inconvenience to the claimant, than mental anguish, till such time as matter is disposed of. Of the other cases, there are, regrettable as it is, many in which some ulterior object is sought to be attained rather than the development of the mineral, among which may be mentioned, the securing of ranch or farm land by means other than those provided under the regulations, headquarters for stock and sheep camps, timber, water power, etc.; the aggressor crying over the shoulder of the "poor prospector."

The investigation and prosecution of such cases, of which there are far too many in this day of commercial honesty, redound to the benefit of the legitimate prospector, while control of the forest protects him in his timber, not only on his claim, which has not always been respected by his more powerful even though distant neighbors, but protects him by reserving the timber in the vicinity of a mineralized district, for the benefit of that district.

It is quite true that such lands as those of the Nevada Consolidated, and in such a district as Bisbee, as Bingham and as numerous other camps and formations, which under the strict letter of the law, might not, and by some of the agents of the several departments, would not, today, be passed upon favorably. This cannot be charged against the departments nor the agents of the departments. There is the law; if unenforced, are not the agents open to charges of malfeasance in office?

Here we touch upon another subject that is current, the changes in the mining laws and the proposed new laws now before Congress. These have been well criticized in the journals of recent date, and justly. There is the most urgent need of changes to meet changed conditions. There are new types of ore formations not contemplated by the law makers of the early days of mining-law construction. These must be met by new laws.

There is but one way that such propositions can be treated. Our knowledge of geology leads us by analogy to assume that valuable ores may be found in a given locality. To meet the case, the government should grant to him who is disposed to back his judgment on such assumption, a concession for the purpose of prospecting the ground and give reasonable protection against interlopers and blackmailers. The law today does not, and in cases in my own experience, I have found that charges have been preferred by individuals, merely with the hope that the defendant will pay him to keep out. The agent cannot always place his hand on the right motive in such cases, the department can act only under the law; to meet the conditions the law must, of necessity, be changed.

Much ado about nothing is made over the extra-lateral-rights phase of the present law. In many cases we find that the companies, by agreement, especially in the newer camps, are adjusting their lines to vertical planes bounding their properties.

In all the eastern states all property is held under such bounds. The law can be amended to provide, upon discovery, for the protection of the discoverer, of his lode on its dip, granting him extra widths of claim over the dip, after allowing reasonable time for its determination, giving him an extra claim, two or three, if required, and without the discovery as specified in the above quoted statutes. These can be taken by legal subdivisions.

I agree with those who would have the claim proved up and patented within a reasonable, given time. This would prevent much of the perfunctory "assessment" work now done, which merely excludes the man who would develop.

Reverting to the causes leading to the abandonment of prospecting, one of the most cogent causes is, tritely, lack of market for the product.

Looking back over the last few years, our mining journals have been filled with "recipes" for making examinations, sampling, measuring "ore in sight," with references and discussions on the last mentioned and other like phrases. Our city-bred engineers, in close touch with the capitalist, and largely influencing him, have insisted on certain characteristics as essential to anything examined, before it is a good investment, before they will recommend it; in short they require the bullion on the dump "with the eagle stamped on it."

It is only within a few weeks past that any one has mentioned the prospect as an object of legitimate investigation and investment. That it has been and today is a legitimate field for investment is surely told in the development of every one of our great mines. Capital is scouring the west for "good gold," "good copper," "good lead," or "good zinc" properties with ore blocked out, etc. Inquiries for such are frequent and repeated and can only be traced to the general trend of sentiment along the lines dinned into the ears of readers for years past. It is evident that there is no surfeit of such properties and without the development of prospects, we must pause and ask, whence is this greed for mines to be supplied?

The country is large, the field has been exploited but little. It is not isolated spots here and there, that remain; the entire country, even at the very doors of camps, well known in mining history, has opportunities for the investigation and investment of the most conservative capital.

There are vast stretches of mountain and foothill country, which have been merely scratched, that were not payable in the day of this casual investigation, yet today would afford a return of profits, satisfying to the most exacting investor. Other fields, because of inherent difficulties, have been passed by without thought, while others, studied by the mine geologist, will inspire favorable consideration and the justifiable expenditure to prove up.

If the investor is to have mines to invest in, and the market the metal required to carry the industries of the world, the prospect must have more consideration and the engineer must qualify for something more than a scaler of ore "in sight" and sampler of "ore blocked out," with his present ability to figure that considering the cost of the property, interest for three, two, and one years, added to the cost of mining, milling, marketing and selling, his employer will get all this back and pay good dividends in addition.

L. S. ROPES.

Helena, Mont., May 15, 1912.

Referring to G. L. Sheldon's excellent letter on "prospecting" in the JOURNAL of May 11, in which he says "Canada, Mexico and South America have better mining laws than the United States," I would like to express the opinion that while ours could certainly be improved upon, as far as acquiring title is concerned they are fairly good and it is not so much that the laws passed by Congress are ineffective, as that it is permitted some clerk in the Land Office to interpret them, and this has been done time and again in Colorado, as more than one of our engineers can testify, and cite the cases. The Courts interpret the laws made by Congress and theoretically no one has the right to go over the Supreme Court's head, and put another construction on them, but it has been done and the Secretary of the Interior has either permitted it, or failed to notice it. It is that which has put new discoveries out of business, in addition to the reasons correctly given by Mr. Sheldon, and as long as the Land Office conservation-reservation-interpretation blight is upon us, the prospector with his frying pan, coffee pot and burro, will only be known as an interesting character in the history of the early and prosperous mining days of the state.

W. WESTON.

Denver, Colo., May 16, 1912.

Copper Determinations at Granby

By Frank E. Lathe*

Description of the uses and limitations of the electrolytic, iodide, cyanide, and colorimetric methods of copper determination, as practiced at the Granby smeltery in British Columbia.

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For the accurate determination of copper in ores and furnace products, the electrolytic method is always used if there be no interfering impurity present—arsenic, antimony, bismuth or lead. If these are present in any considerable quantity, necessitating a separation of the copper before electrolysis, it is better to adopt the iodide method, which, if properly done, is practically as accurate as the electrolytic method at its best, though requiring more manipulation. For approximate results, as on rough hand samples, and where quick work is necessary, as in the case of mattes and slags, the cyanide method is used for large quantities of copper, and the colorimetric method for percentages under about 0.5. The cyanide method, however, is not applicable to ores carrying zinc. The permanganate method is largely used in some places, but appears to require too much time and manipulation for the accuracy secured, to be applied to Granby work.

Electrolytic Apparatus

The terminals for holding the platinum electrodes are aluminum bars, securely held in the wooden back of the electrolytic stand, and measure 3x⅜x¼ in., with a slit $\frac{1}{16}$ in. wide cut in the free end of each for the passage of electrode stems. This slit terminates ⅜ in. from the end in a hole $\frac{1}{16}$ in. in diam., through which a pointed aluminum pin 1 inch long can be forced about half way. These terminals are connected in series, pairs being set 5 inches apart; and the members of each pair, ¼ inch apart, may be short-circuited by means of an aluminum wedge. (A snap switch would be somewhat more convenient to use.) The current is taken from a 110-volt, d.-c. lighting circuit, and is passed through suitable wire and lamp resistances to cut down the voltage for use. The current is ordinarily 0.2 ampere, the voltage between each pair of electrodes being about 3.0. The only change found necessary with a varying number of determinations is to substitute a 32- for a 16-candle-power lamp in the circuit when more than eight depositions are being made at one time. Running as above, one gram of copper will be deposited in about 12 hours.

The platinum cylinders are of the type in general use, having a total depositing surface of 80 sq.cm., and a weight of about 11 grams each. They are standardized once a week, as follows: After dissolving off the copper with HNO_3, each cylinder should be well rinsed in distilled water, then allowed to stand one minute in a boiling hot solution of potassium cyanide, to remove grease or oil, rinsed again through three successive beakers of hot distilled water, and finally through absolute alcohol. Adhering alcohol is then burned off, and the cylinder itself heated to bright redness in the flame of an alcohol lamp. As soon as cool the cylinder may be weighed, and this weight will be used until the next standardization except in the special cases noted below.

Solutions for electrolysis should contain a small quantity of free acid, both HNO_3 and H_2SO_4, but HCl and HF must not be present, as the platinum would be attacked by the chlorine or fluorine set free.

Manipulation

Electrolysis is begun at the close of the day's work, and cylinders are removed in the morning. Before removing the pins which hold the platinum electrodes in place the aluminum terminals are short-circuited by wedges, as noted above, and the cylinders removed at once and rinsed twice through distilled water and once through absolute alcohol. Adhering alcohol is burned off and the cylinder thoroughly dried in the flame of the alcohol lamp, being kept in constant motion during the last two operations to avoid overheating and alloying copper and platinum, as well as oxidizing the surface of the copper. When cool, the cylinder is ready for weighing. The copper is then dissolved in hot dilute HNO_3, and the cylinder, when washed, is ready for a second determination.

When great accuracy is required the dilute acid around the deposited copper is first siphoned off, 500 c.c. distilled water being poured in meanwhile. (If ordinary tap water be used some lime will usually be deposited on the cylinder.) Then the cylinder is removed as usual, weighed, and the copper dissolved. The cylinder is rinsed thoroughly and dried through alcohol, without overheating. A second weighing is now made, and the result used as the correct weight of the cylinder. The errors avoided by these two precautions are counterbalancing, and may, with some operators, be practically equal. Neither should be over 0.03%. Pure copper on the cylinders will be bright in color. Should the deposit be dark it usually indicates the presence of arsenic in the sample, although bismuth will also interfere if present, and sometimes antimony and lead. Lead and manganese are both partly deposited on the anode as oxides, the former being readily soluble in HNO_3 and the latter in HCl, but these are not usually present in appreciable quantities. Silver is ordinarily neglected, but if it is desired to correct for it, the percentage calculated from the fire assay may be subtracted, or it may be precipitated as chloride and filtered off.

Blister Copper Assay

The sample of copper is taken by momentarily deflecting into water the stream of copper as it is poured from the converter. The following method may, however, be also applied to drillings. For the determination, weigh out accurately between 0.9975 and 1.0025 grams of copper, selecting a large number of small pieces. To this copper in the beaker in which electrolysis is to be carried out (battery beaker) add 25 c.c. water and 10 c.c. HNO_3. Heat till all is dissolved. Wash down cover and sides of beaker, and heat a few minutes longer. Then remove from the heat, fill to within half an inch of the top (150 c.c.) with cold water, add 1 c.c. H_2SO_4, and electrolyze. After weighing the deposited copper add or subtract the difference between the original weight and one gram. If the copper be of 98% or better, no other correction will be necessary, and considerable time is thus saved in weighing out the original sample. This method has been carefully compared with the usual one of electrolyzing part of a large volume of solution, and found much more dependable.

Weigh accurately 0.5 gram matte into a battery beaker, add 10 c.c. NHO_3 and warm at a temperature just too low to boil the liquid. (If the sulphur be overheated by boiling it will usually form into a globule which contains undecomposed matte.) When brown fumes cease coming off boil a few minutes gently till liquid is reduced to about 6 c.c., then add 25 c.c. water and heat a few minutes. Finally fill beaker with cold water, add 1 c.c. H_2SO_4, and electrolyze.

For chilled slag, weigh out 2.0 grams slag into a 3½-in. casserole, add 10 to 12 c.c. HNO_3, and take to dryness on hot plate. Cool somewhat, add 8 c.c. H_2SO_4, and heat until SO_3 fumes are coming off freely. Cool, dilute with 25 c.c. water, heat a short time (at low heat, to avoid bumping) transfer to battery beaker, dilute, add 2 c.c. HNO_3, and electrolyze. In the morning siphon off liquid, as described above, remove cylinder and place in a battery beaker filled with hot distilled water. Add 4 c.c. HNO_3, warm (if necessary) till dissolved. Cool,

add 2 c.c. H_2SO_4, and again electrolyze. Again siphon off liquid, weigh cylinder, dissolve copper and reweigh. The reduction by redepositing, and reweighing the cylinder, will vary up to about 0.05 per cent.

Another method for slags is to weigh 5.0 grams of slag into a 600-c.c. beaker, containing 150 c.c. boiling water. While stirring well, add 25 c.c. boiling HCl, and when the slag is decomposed, dilute with hot water to 500 c.c. Remove from heat and pass in H_2S gas for three-quarters of an hour. Filter into suction flask, and remove paper from funnel as soon as filtration is complete, to avoid oxidation. Wrap in second filter paper, and place in porcelain crucible. Burn off paper at low heat in muffle, cool, and transfer to battery beaker with 5 c.c. HNO_3. Heat until copper is dissolved, add 25 c.c. water and again heat for a few minutes. Dilute with cold water, and add 1 c.c. H_2SO_4 before electrolyzing. Siphon off weak acid and reweigh cylinder, but it is not necessary to redeposit copper. This checks with the former method, but requires more manipulation.

For unchilled slags weigh out 2.0 grams of slag into a battery beaker, add 10 c.c. HNO_3, and heat about 10 min. Then add 8 c.c. HF, and warm till violent action has ceased. Cool, add 8 c.c. H_2SO_4, warm a few minutes, then transfer to a platinum crucible or dish, and heat till SO_3 fumes come off freely. Cool, and finish as under chilled slags, after H_2SO_4 treatment. Should traces of HF remain, as is often the case, the reweighing of cylinders will correct for it.

For ores, weigh 1.0 gram into a battery beaker, add 10 c.c. HNO_3 and then treat as under mattes. For custom ores check this with a 2.0 gram sample, using 12 c.c. of acid to decompose. Then after depositing copper, siphon off liquid and redeposit both. Many ores will give good results on first deposition, but unless this be known of a familiar ore the extra precaution should be taken.

Iodide Method

Weigh out two portions, of 0.5 and 1.0 gram, or double these quantities on low-grade ores, and treat with 10 to 15 c.c. nitro-hydrochloric acid in casseroles. Take slowly to dryness on the hot plate, cool somewhat, add 8 c.c. H_2SO_4 and heat to copious SO_3 fumes. Cool, add 25 c.c. water, and warm for 10 min. Filter into a 250-c.c. beaker, and wash at least seven times. Dilute to 75 to 100 c.c., place a triangle of sheet aluminum in the liquid, and boil till all the copper is precipitated —about 15 min. Wash down the cover and sides of beaker with H_2S water, using 15 c.c., and if not more than 10% copper be present, decant liquid and wash loose copper into filter, using a jet of H_2S water, with which also wash filter four or five times, being careful not to let the filter stand empty. (If there be a brown tinge in filtrate it indicates a loss of copper.) Place under funnel a clean 250-c.c. beaker. Pour over the aluminum in the other beaker 6 c.c. of 1:1 HNO_3, cover, and heat two minutes. Then pour this acid over filter to dissolve copper. Follow this with 5 c.c. saturated bromine water, and wash beaker and filter with hot water. Open filter and wash any dark residue into the beaker with the solution. (In the case of high-grade copper ores the precipitated metal should be washed by decantation with H_2S water four times, after which the copper is dissolved as before, but before giving the bromine treatment most of the red fumes should be boiled out of the filtrate.) Boil the liquid to expel bromine fumes completely. Cool somewhat and add a slight excess of ammonia. Boil a short time, then make acid with acetic acid and boil again. (These precautions appear to be necessary to make the neutralization complete, but when they are taken the excess of ammonia need not be boiled off.) Cool to room temperature, add 6 c.c. of a 50% KI solution. Titrate with a solution of $Na_2S_2O_3$ of value 2.0 milligram copper per c.c. till the liquid is only faintly colored with free iodine. Then add 5 c.c. fresh starch solution and continue the titration till the blue color just disappears.

Cyanide Method

For mattes, weigh out 0.5 gram matte into a 400-c.c. beaker, add 10 to 15 c.c. HNO_3 and heat at moderate temperature till decomposition is complete. Add 175 c.c. cold water, and ammonia to 10 c.c. excess. Cool to room temperature. Add from a burette, KCN solution of strength 1.0 c.c. equals 10 mg. copper till a change in the color of liquid indicates that the reaction is nearly complete. Allow to settle a few minutes, and continue the additions of KCN, with alternate settlings, till the blue color has just disappeared. A sample of matte in which the copper has already been determined electrolytically is run with the unknown sample as a standard. The method as thus carried out for mattes is not accurate within 0.5%, but for ordinary purposes this is sufficient. The accuracy may be increased by precipitation of the copper, and other precautions, but then becomes as slow as the more reliable iodide method. For ores, use from 1.0 to 5.0 grams, depending on the percentage of copper present, and if much accuracy is desired run as a standard a similar ore of known copper content. The manipulation is as for mattes.

Colorimetric Method

Colorimetric methods are particularly for use with slags, and the endeavor is to give them similar treatment. Weigh out 30 mg. clean copper foil into a beaker, dissolve in weak HNO_3, transfer to measuring bottle, and make up to exactly 180 c.c., so that 6 c.c. contain 1.0 mg. copper. Weigh into each of five 3½-in. casseroles about 150 mg. iron wire, and 50 mg. aluminum foil. Dissolve in 10 c.c. HCl and 5 c.c. HNO_3, dilute to 75 c.c., and to the five solutions in casseroles add 12, 18, 24, 30 and 36 c.c. respectively of the standard copper nitrate solution. Precipitate all with ammonia, using an excess of about 10 c.c. and warm for 10 minutes without actually boiling. Filter into colorimetric bottles, and make each up to the mark—150 c.c. These will be equal to 0.2, 0.3, 0.4, 0.5 and 0.6% copper, if 1.0 gm. be taken for sample. These standards keep well, but samples run by them must be checked occasionally by electrolytic determinations. Standards are usually slightly darker in color than solutions of slags containing an equal amount of copper, but in practice an allowance may be easily made for this, so that the error on single samples will not usually be over 0.02 per cent.

Ordinary tap water is used in the determination of copper in slag, and might be used in the preparation of standards except for the deposition of lime on bottles after long standing. Weigh 1.0 gram slag into a 3½-in. casserole, add 10 c.c. HCl and put on hot plate. After 10 min. add 5 c.c. HNO_3 and heat till action has ceased. Dilute to 75 c.c. with cold water and add ammonia in moderate excess. Warm, without boiling, for 10 minutes. Filter through 15 cm. No. 595 S. & S. filter paper into colorimetric bottle, washing twice. Make up to mark with cold water and compare with standards.

Ores are run similarly to slags, but use 0.5 to 5.0 grams of sample, according to the amount of copper apparently present. (If the ore be high in iron do not use over 2.0 grams.) If the quantity of ore taken proves too large, and the color of the solution be darker than that of the 0.6% standard, dilute just half of the solution to standard volume and compare. When the error on a copper ore is required to be less than 0.1% run as standards along with the unknown sample about three similar ores. Thus if ore appears to carry about 1.25% copper run 0.5 gm. each of the sample and of ores with 1.0, 1.2, and 1.4% as determined electrolytically. In this way the copper content may be judged within an average of 0.05%, which is rather better than the results by the cyanide method on similar ores.

Nevada Hills Mining Co.

The report of the Nevada Hills Mining Co. for the year ended Mar. 31, 1912, states that the construction program is completed, the total expenditure for this purpose being $502,918. The Webber shaft was sunk 501 ft. during the year, making the total depth 701 ft. The total cost of this shaft was $52,637. Exclusive of the Webber shaft, 3863 ft. of development work was done, mostly in connecting up this shaft with old workings

and with the Nevada Hills shaft, in order that the ore may be economically handled in the future.

The new mill began operations Sept. 12, 1911, and continued until Jan. 13, 1912, when a temporary shutdown was necessitated because the power company could not furnish power owing to water shortage. Operations were not resumed until Apr. 15. During the four months' operations 10,948 tons were milled averaging $26.83 per ton, a recovery of 88.8% being obtained.

Rapid Sinking on the Rand

The southeast shaft of the Government Gold Mining Areas (Modderfontein) Consolidated was sunk 233 ft. during March, 1912, which is a record for shaft sinking on the Rand. Credit for this achievement is due to Martin H. Coombe, the manager, and to Lowson, Readhead & Robar, the sinkers. The previous record, states the *South African Mining Review*, was 213 ft. at the Modder Deep, beating the July, 1907, record at the south shaft of the Brakpan Mines. During the quarter, 583 ft. was sunk at the State Mines, which is also a record; the previous record being 532 ft. at the Brakpan mines.

The shaft in which the record was made is divided into seven compartments, the excavation being 45x10 ft. The tonnage of excavated material hoisted for the month for the 233 ft. sunk was 8155 tons, equal to 35 tons per foot. The sinking was done between the 1738- and 1971-ft. levels, through 155 ft. of quartzite, and 78 ft. of shale, or less than one-third in Kimberley shale, in sinking through which all previous records have been made. Natives did all the hand drilling and shoveling; 82 natives and a white assistant comprised the sinking crew for one shift; eight-hour shifts were worked seven days per week. The majority of the men drilled double-hand, using 7-lb. hammers; single-hand men worked only on the end benches.

The Routine of Sinking

In sinking this shaft the excavated material is hoisted in skips. An endeavor is made to keep the bottom flat, an ideal bottom being one with a bench only at each end. Blasting takes place every eight hours. From 40 to 45 holes square the shaft and complete a round for a shift. These holes are drilled from 3 ft. 6 in. to 5 ft. deep, advantage being taken of the bedding planes, and the majority of the holes are inclined to the north against the strata; four are drilled abreast for the length of the shaft. The side holes are given the desired lift from a plumb line hung from the bottom set. Blasting gelatin is the explosive used. No pump is installed in the shaft below the 600-ft. level. The water is handled with the sinking skips from rings at various points, 30 skiploads per shift being hoisted.

Four timbermen are employed in each of the four shafts which are being sunk on the State Mines; two men and six native laborers, being bottom-set men, one man and four laborers working at the hitches, bearers and permanent guides, and one laborer at the brattice. All timbermen work morning shift only, from 7 a.m. to 3 p.m. After the sinking shift is in the bottom and hoisting is commenced, the two bottom-set men block the next to the bottom set, using the bottom set to carry the stage planks. The men are not allowed to interfere with the skips, once they have reached their place of work, until the sinker has finished cleaning up and has started drilling. Then the engines are used by the timbermen to hang the next set. From the time the banksman shackles on the first pair of wall plates until the set is in place and the timbermen are at the surface again with their stage planks and crew is from one to 1½ hr. Timbermen are not allowed to attend to tight ground; the sinker is responsible and is compelled to take it down. If a set of permanent guides is required or a set of bearers is to be taken down, as soon as the timbermen have hung the wall plates and the filling-in timber has been sent down they hand the engine over to the sinker. As much as 57 skips or 114 tons of rock have been hoisted from the bottom, one set of timber blocked, another hung and filled, four 3-ft. guides hung and bolted in the shaft, and the shaft bottom drilled in the usual manner and blasted a quarter of an hour before the end of the shift. All hitches are cut, bearers installed and timber dropped or lowered, while the shift is at work in the bottom.

All Timber Framed by Hand

There are 132 cu.ft. of pitch pine in each set. The guides are 8x4-in. pitch pine carried on channel brackets, bolted to the dividers. Lagging, when any is used, is 12x12-in. pitch pine. Bearer sets are put in approximately every 120 ft. Hitches are cut to a minimum depth of 4 in. Wire plumb lines are dropped once per month to check the timbermen's lines. All the framing for timbers, guides, ladders, rings, etc., for the four shafts is done by hand by three men. Recently 64 sets at 7-ft. centers were placed in 61 consecutive days. Six 1⅛-in. iron hanging bolts per side are required, three for each half plate. The wall plates made in two pieces are butt-jointed on a divider, no plating or bolts being used.

Shaft and Surface Equipment

The south or pump compartment measures 8½x6½ ft. in the clear. Each of the six other compartments measures 6½x5 ft. in the clear. The pump compartment is further divided into compartments for ladderway, repair cage, and pipe bearers and columns. The power cables are carried down in the space between the wall plates and the repair-cage guides. Acetylene lamps are used exclusively.

No fan installation or pipes are used. A wooden chimney of sectional area equal to that of the pump compartment is taken up above the headgear. A ⅞-in. brattice between the pump compartment dividers is carried down with the timbering. This induces a draft of from 20,000 to 25,000 cu.ft. of free air per min.; 10 minutes after blasting the bottom is clear of smoke and fumes.

The shaft is equipped with a modern steel headframe 110 ft. high from collar to platform, covering all the compartments. Two double-drum engines are used, one a first-, the other a second-motion hoist. The drums are 8 ft. in diameter. The boilers are Babcock & Wilcox dutch-oven type. A 50-drill compressor has been also installed but is not used. The winding ropes are 1⅛ in. diameter. Sinking skips of 45-cu.ft. capacity are used. White and native change houses, shops, etc., are of the most modern design and construction. Massive concrete collars have been put in, built up from the solid rock to from five to six feet above the surface.

Gowganda District, Ontario

Gowganda Correspondence

The mining situation around Gowganda is quiet and there is little activity in the development of new prospects. Inaccessibility and lack of transportation continue to handicap the district. An improvement in this respect should be effected soon by the completion of the branch of the Temiskaming & Northern Ontario Ry. to Elk Lake, and also, it is hoped, by the improvement of the present wretched wagon road from Elk Lake to Gowganda. At the present time, three mines are operating steadily and producing ore. The Mann mine has recently purchased the property and plant formerly owned by the Boyd-Gordon Mining Co., and adjoining that property. Both high-grade and concentrating ore are being developed on the 90-ft. level at the Mann and a new shaft will be sunk soon for the development of the eastern ore-body, from which excellent ore was taken near the surface during the last winter.

The Miller Lake-O'Brien mine has made additions to the mining and sorting plant, and now has a capacity of 14 drills. The development work is largely confined to the 250-ft. level, where an aggregate length of over 200 ft. of high-grade ore has been opened. The vein in places has a width of 6 to 8 in., assaying 3000 to 4000 oz. per ton in silver. Stoping is progressing steadily and

the production consists approximately of 20 tons of high-grade ore each month.

The Milleret mine is operating steadily its 10-stamp concentrating mill, and is treating 1000 tons of ore per month, producing from 25 to 30 tons of concentrates. Developments are being carried on along the 200- and 150-ft. levels, and a fair amount of concentrating ore is blocked out, also some high-grade, which is sorted out underground.

Aside from these producing mines, five prospects are at present the object of vigorous development: The Willing, Hudson Bay, Homestake, South Bay and Powerful. Good reports come from all of these properties and some high-grade ore is being taken out in the course of development.

There are a great many properties which may be classed as promising prospects, on which more or less development work was done in the past, and which are at present closed down, mainly through lack of funds on the part of their owners to carry on further operations. Some of these are likely to resume operations in the near future, and it is probable that all will receive more or less attention after the transportation conditions are improved.

Inspiration Consolidated

MIAMI CORRESPONDENCE

The development and construction program of the Inspiration Consolidated Copper Co., entailing the employment of over 1000 men and the expenditure of nearly $7,000,000 near Miami, Ariz., during the next two years, has been started. The site finally selected for the concentrator is about one mile east of the Inspiration mine and a mile north of the town of Miami. Managing Director W. H. Aldridge has just finished a visit to the property and has settled the main points of the program. He says:

The site for the 7500-ton concentrator has been decided upon and all the necessary land secured. It will consist of six sections of 1250 tons each. The flow-sheet, or method of concentration, recommended by J. M. Callow, who has been conducting tests on the ore for the last five months, will be adopted. It is the logical extended application of the principles of the roughing system developed by the Utah Copper Co. The general arrangement of the working shafts, crushing plant, and concentrator have been agreed upon and the details of mill design, shaft equipment and the specifications for machinery will be left to the company's engineers, Repath & McGregor. About 100 men are working underground and the number will be rapidly increased as soon as additional compressor facilities can be provided. A large amount of work must be done underground before the mine will be ready to supply the mill, and there will soon be as many men employed in and around the mine as there will be when the mine is producing at the rate of 7500 tons per day. Grading has already been started and the contract will be let in a few days for two large concrete working shafts and for railroad construction consisting of about eight miles of track. The steam-power plant will have a capacity for generating a minimum of 7500 hp., and the power will be distributed to the mill, mine, shops, etc., by high-tension, electric current.

There will be nearly $7,000,000 expended in the development and equipment of the mine and the construction and equipment of the concentrator, power house, etc., and over 1000 men will be employed within the next few months. I look for a period of great prosperity for the district.

Mr. Aldridge stated that as soon as a general manager is appointed, which will be within two weeks, he will make his headquarters in New York instead of in Los Angeles as at present.

Ancient Mine Workings in The Transvaal

JOHANNESBURG CORRESPONDENCE

Ancient mine workings occur over a wide area in Rhodesia and are found as far South as the Transvaal. T. G. Trevor has collected many facts about these which he communicated in a recent paper before the Chemical, Metallurgical and Mining Society of South Africa. The natives now inhabiting the Transvaal have worked iron and copper ores on a very small scale; however, large workings for tin, iron, copper and gold exist and are probably the work of the same race responsible for the Rhodesian workings.

Workings are usually indicated by a line of depressions and these workings have in many cases been intentionally filled in, and in some cases deliberately concealed. There are no roads, ruins or inscriptions and no large tailing or slag heaps. At the Rooiberg tin mine, there is an accumulation of slag and some smelted tin, and bronze ingots were found. Stone hammers for use without handles have been found in the workings, and at Rooiberg some mine gads. The dumps left have been picked practically free from metal; at the Messina copper mine scarcely a trace of ore was obtainable, and at the Rooiberg tin mine the extensive ancient workings were for a long time believed to be iron workings only.

The "rubble" from the dumps of gold workings is not as in Rhodesia often payable, but contains practically no trace of gold, showing that these workers treated the very lowest grades of ore. No pillars of ore are left in the workings which are mostly underhand surface stopes or opencuts.

No profitable gold mine has been established on ancient workings in the Transvaal, unless we exempt some of the bedded deposits in the Lydenberg district, which are said to have shown some old work. The successful Messina copper mine in the northern Transvaal was established by exploring three parallel lines of workings running for about a mile. Some of the ancient excavations were 80 ft. deep by 30x10 ft. and bottomed on solid copper glance. It is estimated that the old workers must have removed at least 10,000 tons of copper from this vicinity. Even larger copper workings exist in the low veldt at Palabora. From the tin mines the old workers must have removed 2000 to 3000 tons of tin, as the workings at Rooiberg, Weynek, and Leeuwpoort in the Waterberg district are extensive.

Large workings exist all over the northern Transvaal, presumably for iron ore, as no other mineral has been yet found in them; but there is some mystery about these, as tin ore appears in many cases to be found, and it is possible that some other mineral has been completely removed.

Who these indefatigable workers were and whence they came still remains an unsolved problem. The Phœnicians certainly knew the coast and may have penetrated inland, and they may have found a race (since vanished) inhabiting Rhodesia and the Transvaal, who were natural miners and ready to exploit their mineral deposits for trade and barter. The Portuguese are responsible for many so called ancient workings in Rhodesia, but are scarcely likely to have been employed as far south as the Transvaal. Probably the news of an invading tribe from the North caused these workers to conceal their mines and flee, or they perished in a sudden raid such as the Zulus delighted to make upon their less warlike neighbors.

Mineral Production of Russia

SPECIAL CORRESPONDENCE

The statistics of production of the chief metals and minerals in Russia in 1911, as collected by the Association of Russian Manufacturers and Traders, are as follows, the Russian measures being converted into kilograms and metric tons:

	1910	1911	Changes
Gold, kg. fine.	53,513	52,138 D.	1,373
Gold, value...	$35,566,045	$34,550,609 D.	$915,436
Platinum, crude, kg...	5,481	5,432 D.	49
Copper, tons.	22,619	25,097 I.	2,478
Zinc, tons....	8,631	9,652 I.	1,021
Pig iron, tons.	3,042,046	3,588,449 I.	546,403
Steel, tons....	3,542,552	3,948,487 I.	405,945
Coal, tons....	23,105,628	16,678,280 D.	6,427,348

These figures are considered more reliable than those of the government, for the reason that the official statistics are used as the basis of taxation or royalties charged to the producers, who are, therefore, interested in keeping them as low as possible. Crude platinum contains 83% pure metal.

[The pig-iron figures, apparently, include only the iron sold or delivered in the form of pig, castings, etc., and not that converted into steel.—EDITOR.]

Details of Practical Mining

Accounts of Useful Ways of Doing Many Things in the Day's Work

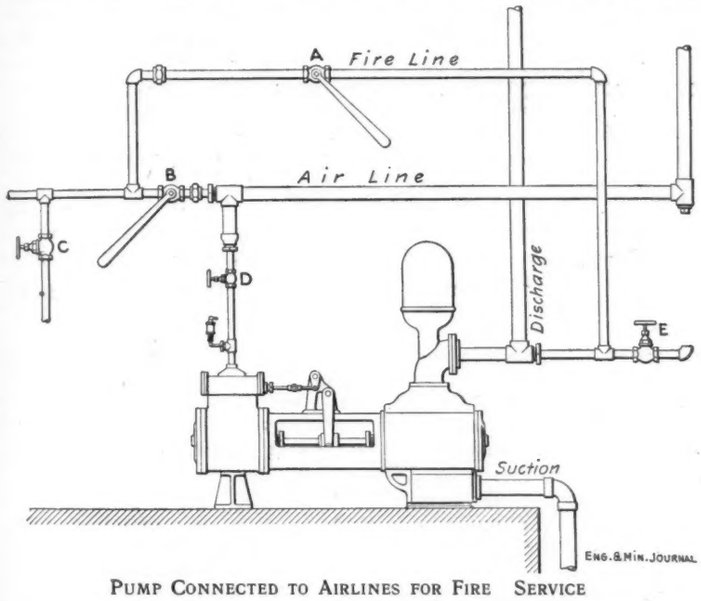
Pumps for Fire Protection

By A. W. Newberry*

At the Belen mine of the Sierra Mining Co., Ocampo, Chihuahua, Mexico, recently closed on account of revolutionary disturbances, a simple and effective means of fire protection was made necessary by the presence of a large quantity of dry pine timber in one of the main haulage ways.

A Smith-Vaile, 8x5x10-in. duplex pump, situated on the 950-ft. level, handled all the mine water from a main sump. The water level was kept within 4 ft. of the station, so as to provide sufficient water in case of fire. The pump, which was supplied with air at 90 lb. pressure, could raise 50 gal. per min. against a head of 185 ft. To turn this water into the mine, a 2-in. pipe was provided, so as to connect the discharge end of the pump with the main air line to the drills, as shown in the accompanying sketch.

The valve shown in this line at *A* was kept closed, and the valve in the main air line at *B* was left open to allow the passage of air. In case of fire, the valve *B* could be closed; the release at *C* opened to bring the air in the line down to atmospheric pressure, and the pump started, if not running, by opening the valve *D*. If necessary, the pump could be quickly primed at *E*. As soon as the valve *B* was closed, the pumpman signalled the men at the working face by striking the pipe. These men then proceeded to disconnect the pipe at a point as near as possible to the fire, unions being provided every 120 ft. for this purpose. Over each union was hung a hose connection, and one 50-ft. armored hose was kept in the station for use in case the hose in the face could not be reached. As soon as the hose was connected, the pipeman signalled by striking the pipe twice, and the pumpman opened the valve *A*, allowing water under 185 ft. head to flow through the air line. This arrangement obviated the necessity of a valve in the discharge column, and allowed all excess water to escape through the latter.



Pump Connected to Airlines for Fire Service

*Assistant general superintendent, Mammoth Mountain Mining Co., Isabella, Calif.

Drinking Fountains in Mines

Sanitary drinking fountains were recently installed in the No. 7 hard-ore mine at Ishpeming, Mich., of the Oliver Iron Mining Co. The innovation proved to be such a success that similar fountains will be installed in all the mines as well as in the shops and offices of the company.

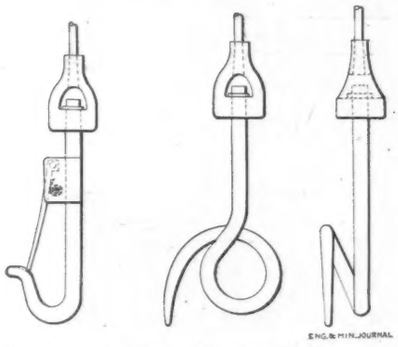
The drinking fountains were described in the Journal of Mar. 23, 1912, as used in the Republic mine of the Cambria Steel Co., at Republic, Michigan.

Joplin Hoisting-Bucket Hooks

By Claude T. Rice

The greater part of the ore produced by the Joplin mines is raised to the surface in buckets of 800 to 850 lb. capacity. These buckets are loaded in the stopes, trammed on platform cars to the shaft, where they are hooked to the hoisting rope and raised at such a speed that a round trip from a depth of 250 ft. is made in 35 sec. In many of the sheet-ore mines, 500 buckets are raised in a shift of 7½ hours, while in others, 700 and even 900 buckets are raised each shift, week in and week out.

To maintain hoisting at this speed, a hook must be used on the hoisting rope that will permit the hooking and unhooking of buckets with the utmost facility.



Snap and Pig-Tail Bucket Hooks used in Joplin Mines

Two types of hooks are in use; the snap hook, illustrated in Fig. 1, and the "pig-tail" hook, shown in Fig. 2. The snap hook is generally preferred, and is considered the safer.

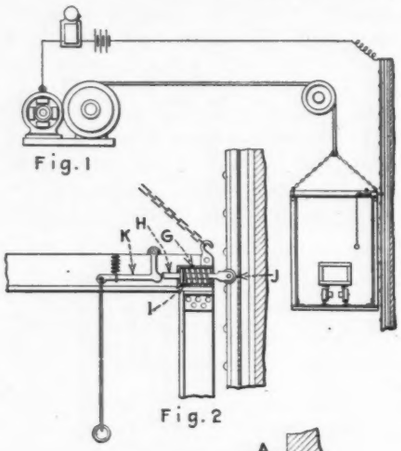
The snap hook is made of 1¼-in. steel and the snap is held in a groove in the point of the hook by a coiled spring that is housed in the sheath welded to the shank of the hook. The pig-tail hook is made of 1¼-in. iron, bent in a spiral 4 in. in diameter and of 2-in. pitch, which permits easy entrance of the 1¼-in. bail of the bucket. Both the snap hook and the pig-tail hook are attached to the hoisting rope by a swivel.

The hooks in time become worn by the bail of the bucket, and it is common practice to repair the worn snap hooks by welding a piece of iron to the inside face after the hook has been hammered out straight. When the weld has been completed, the hook is heated and bent to its original shape.

Signal Device for Mine Cage

The object of the device illustrated in the accompanying sketch, is to provide a simple and inexpensive signal which can be applied to a mine cage so that a passenger can at all times instantly signal the hoisting engineer.

A pair of vertical strips, *A*, in Fig. 3, are secured to the wall of the shaft *B*, each of the strips being formed on its inner side face with a U-shaped recess or opening *C*. Strips of insulating material *D* are firmly secured in the openings *C*, and are formed with comparatively narrow slots *E*, within which there is secured a conducting strip *F*, which is preferably made of aluminum. The insulating strips *D*, have each a chamfered edge in order to allow the roller contact member carried by the cage to have easy access to the metal conducting strip.



DEVICE FOR SIGNALLING FROM A CAGE

The cage carries on its top a housing *G*, within which is slidingly mounted a plunger which is engaged by a coil spring in the interior of the housing that surrounds the plunger and is engaged between one end of the housing and a collar *I*, carried by the plunger. The other end of the plunger carries a roller *J*. It will be seen by Fig. 2, that under normal action of the spring the plunger occupies the position wherein its roller is out of contact with the metal conducting strip. A bell-crank or L-shaped lever *K*, is pivotally suspended from its shorter arm and its longer arm is connected to a coil spring, the latter being of the retractile type and being supported at its upper end from the cage top. The normal action of the spring is to hold the longer arm of the bell-crank lever in a suspended position so that the nose of the bell-crank lever exerts but little pressure on the plunger. A cord or rope is attached to the free end of the horizontal arm of the bell-crank lever and extends downwardly on the cage so as to be conveniently accessible to any of the occupants.

As shown in Fig. 1, the hoisting engine is connected by the usual wire or cable with the cage. A bell is placed in the engine room, or at such points that its ringing will be audible to the engineer or operator. A wire connects the framework of the hoisting engine with the bell and a wire leads from the battery to the metal strip on the wall of the shaft.

In operation if a passenger in the cage desires to signal the engineer he pulls the cord downward thus pushing the nose of the bell-crank lever into engagement with the plunger, causing the roller to come in contact with the conducting strip. Thus a circuit is closed causing the bell to ring. Any other signals such as the semaphore may be used in lieu of the bell. This device has been patented (U. S. pat. 562,188) by Lee Bayer, of Willisville, Illinois.

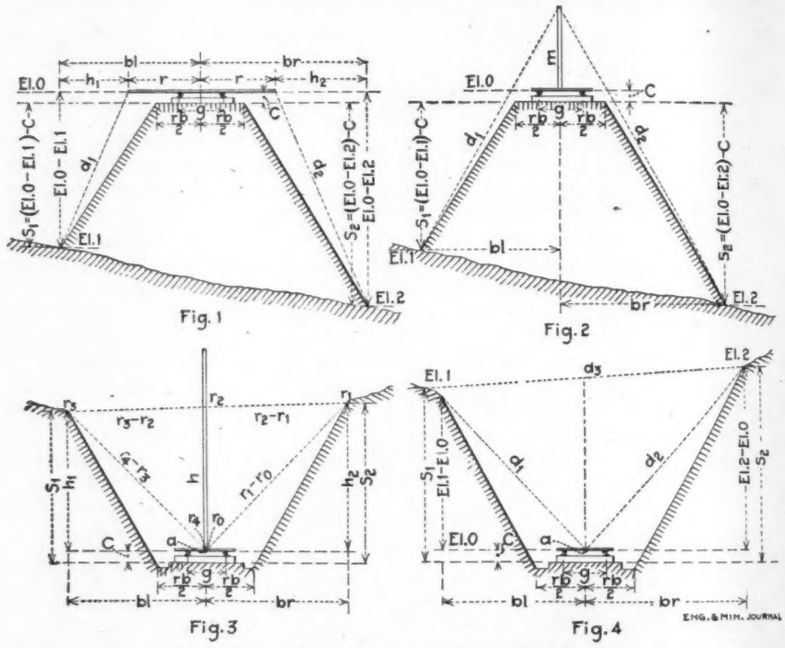
An aluminum alloy, composed of aluminum, 92%; copper, 5%; bismuth, 2%, and silicon, 1%, has been patented by Gaston Jacquier, of Belgravia, Transvaal. It is claimed, according to the *Brass World*, that this alloy will withstand the corrosive action of sulphuric acid better than other alloys of aluminum, and hence is especially suitable for making castings to be used in mines.

Surveying New Cross Sections for Embankments

BY LEE FRASER*

In surveying for new cross-sections for about 50 km. of the Rio Mulato-Potosi branch of the Antofogasta to Bolivia railroad, it was found, in many instances, impossible to obtain a complete section with one set-up of the instrument, or to measure horizontal distances without many times breaking chain. To overcome the latter difficulty especially, the methods herein described were evolved.

For sections of embankment two methods were used, as shown in Figs. 1 and 2. For the method shown in Fig. 1, a track-gage was made with ends projecting out the distance *r* from the center, and graduated to 10 cm. for convenience in measuring the width of the road bed.



METHODS OF MEASURING FOR CUT AND FILL DATA

In taking a section the distances d_1 and d_2 were measured, and the elevations were taken on rail and toes of the slope. Then:

$$bl = r + h_1$$

$$br = r + h_2$$

$$h_1 = \sqrt{d_1^2 - (El.\,0 - El.\,1)^2}$$

$$h_2 = \sqrt{d_2^2 - (El.\,0 - El.\,2)^2}$$

Except for inconveniences in measuring the road bed, the method shown in Fig. 2 was found preferable to the one just described. A rod-level was used to plumb the rod. The procedure was then the same as in the first method.

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*Mining engineer, Apartado 168, Oruro, Bolivia, S. A.

$$bl = \sqrt{d_1^2 - (El.\ o - El.\ 1 + m)^2}$$

$$br = \sqrt{d_2^2 - (El.\ o - El.\ 2 + m)^2}$$

For sections for excavation, the methods shown in Figs. 3 and 4 were used. In Fig. 3 a level-rod is shown pivoted to a track-gage, so that the base of the rod will have the elevation of the top of the rail, and is so constructed as to be free to swing from side to side for plumbing. The zero end of the tape is attached to the center of the track-gage, then it is stretched to r_1, thence to r_3 and back to the center of the gage. The tape is then read from r_0 to r_1; from r_1 to r_2; from r_2 to r_3; and from r_3 to r_4. Since h is the elevation above the top of the rail when the tape stretched from r_1 to r_3 meets the rod, h should be corrected by the amount of sag.

When, as shown in Fig. 4, the rod could not be used, the distances d_1, d_2 and d_3 were measured and the elevations were taken on the rail at the center and the sides of the cut. The distance d_3

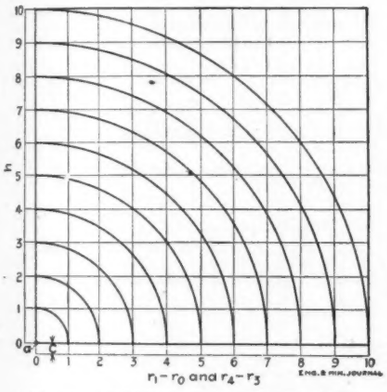


FIG. 5. DIAGRAM FOR CALCULATING

was not necessary for the computation, for bl and br served as a check when the diagrams were plotted.

To obtain the depths of the cut, the distances S_1 and S_2, as shown in Figs. 3 and 4, a large-scale diagram was made as shown in Fig. 5. The point a in the diagram represents the point a in both Figs. 3 and 4. With the point a as an origin, ordinates and abscissas are drawn, beginning at a distance below a equal to c in Figs. 3 and 4. It will then be seen that radial lines from the point a represent the distances $r_1 - r_0$ and $r_4 - r_3$ of Fig. 3, and d_1 and d_2 of Fig. 4. In Fig. 3, the depths and widths of the cut, S_1 and S_2, and bl and br, may be taken directly from the diagram by describing arcs with radii equal to the distances $r_3 - r_1$, or $r_3 - r_2$, and with centers at points above a equal to the distance h_1, so as to intersect the arcs previously described with radii $r_1 - r_0$, or $r_4 - r_3$, and center at a. In Fig. 4, the distances bl and br are obtained directly from the diagram from the intersections of the arcs described with centers at a and radii equal to d_1 and d_2, with the projections of S_1 and S_2.

Blasting in Wet Shafts

BY E. M. WESTON*

It frequently happens, especially when shaft sinking with machines is in progress in wet shafts, that the pumps have to be withdrawn before blasting. This may mean that the water has risen to a height of several feet above the bottom of the shaft before the holes can be fired.

If fuses are used they should be well greased just where the detonator has been placed on one end and inserted in the primer. It is true economy to use two fuses and two detonators in the leading or cut holes of the round thereby lessening any risk of the whole round being hung up by missfires. All fuses should be of the same length, from 6 to 12 ft. depending upon the number of holes to be fired. In large shafts on the Rand 12-ft. fuses are used. As soon as the holes are charged the ends of the fuses are tied to a small plank or a wedge that has been used to rig the base for the machines, six inches or more of the end of the fuses projecting above the plank and as the water rises all fuse ends float.

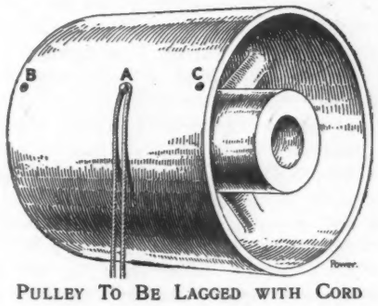
The miners work in pairs lighting the fuses from the back of the shaft toward the bucket or skip in the center. "Cheesa sticks," as they are called locally are made by splitting blasting gelatine and wrapping it around pine sticks about 18 in. long. In a wet shaft the fumes given off though poisonous are rapidly absorbed by the water and the use of such sticks in shaft sinking is justified. One miner carries the lighted stick and the other cuts each of the back row of fuses about one inch from its end and rapidly bends it back, while the other miner applies the stick before the composition becomes damp. When the fuse is seen to spit the next one of the row is lighted. If the fuse does not take fire after the first cut has been made, another cut is made, and no fuse is left until it is seen to spit. The next rows are dealt with in the same way except that the fuses are cut several inches further down so that each row nearer the center of shaft will explode before those first lighted.

If considered more convenient the reverse order of lighting may be adopted, but the advantage of lighting the back rows first is that the men are near the bucket when all the fuses have been lighted; they are not obliged to walk over lighted fuses to reach the bucket. In this way fuses can be lighted with certainty even in the wettest shafts and it is worth while at mines where lower-grade explosives are used to have some blasting gelatine on hand with which to make these lighting sticks, as gelignite and dynamite are too granular and brittle for the purpose. Substitutes for "cheesa sticks" made of chemical combinations and designed to give off no carbon monoxide or nitrous oxide are being introduced with more or less success for general mine work on the Rand. I have not, however, heard that they have been used successfully in wet-shaft sinking.

*Union Club of South Africa, Johannesburg, Transvaal.

Cord Lagging for a Pulley

To cover a pulley cheaply and quickly, states D. H. Hull in *Power*, drill a small hole about $\frac{1}{8}$ in. diameter in the face, as shown at *A* in the accompanying sketch, and drive in a small pin and cut off about $\frac{1}{8}$ in. above the pulley face; then obtain a continuous hard, twisted cotton cord $\frac{1}{8}$ in. diameter and free from knots, and loop the middle point of the cord over the pin. With the free ends held tight, turn the pulley in the direction of rotation, applying a good coat of belt glue as the cord is wound on the pulley. When the face of the pulley is completely covered, draw the free ends through the holes marked *B* and *C* on the sides and fasten with a soft wooden pin well covered with glue. As soon as



PULLEY TO BE LAGGED WITH CORD

the glue hardens, the pulley will be ready for use.

The pulley surface should be thoroughly cleaned before applying the glue. As the cord forms a right- and left-hand thread, so to speak, the belt will tend to work from the side to the center, which will insure the belt running on the center of the pulley. The length of cord for one turn may be found approximately by multiplying the diameter of the pulley by $3\frac{1}{7}$, and this multiplied by the number of turns necessary to cover the face will give the total length. This pulley cover is easily cleaned and will last a long time.

The purpose for which such lagging is used is usually to prevent slipping, but heavy cord may also be used in the same way when it is desired to slightly reduce the speed of the pulley.

The practice of loading holes to the collars is attended by an increase in the quantity of powder consumed, but the extra cost for explosives may be offset by the greater facility in shoveling due to more thorough shattering of the rock.

Details of Metallurgical Practice

Records of Experience in Ore Dressing, Cyaniding and Smelting

Amalgamation Tables for Huntington Mills

The amalgamation tables used in connection with Huntington mills differ from those usually used with stamps in that they are covered with several small copper plates set in sequence and so that there is a small drop from one plate to another, whereas the common type of table used in front of stamp batteries is covered with one large sheet of copper. The fall between plates seems to be a more desirable feature in Huntington-mill than in stamp-battery tables, although the reason for this is not perfectly clear. However, it is a fact that most of the gold is caught on each plate at a distance of about four inches beyond the drop.

It is a more difficult task to make a table with drops than a plane table, because of the tendency of the former to leak at the joints. A leaky table is an abomination to the millman and a source of loss to the owners. A well designed and well made table will not leak even after having been subjected to the vibrations of the mills for years. Tongued and grooved flooring may be used on the tables, but there is the possibility of a flooring constructed in this way swelling laterally enough to push the side cleats over the edge of the copper plates.

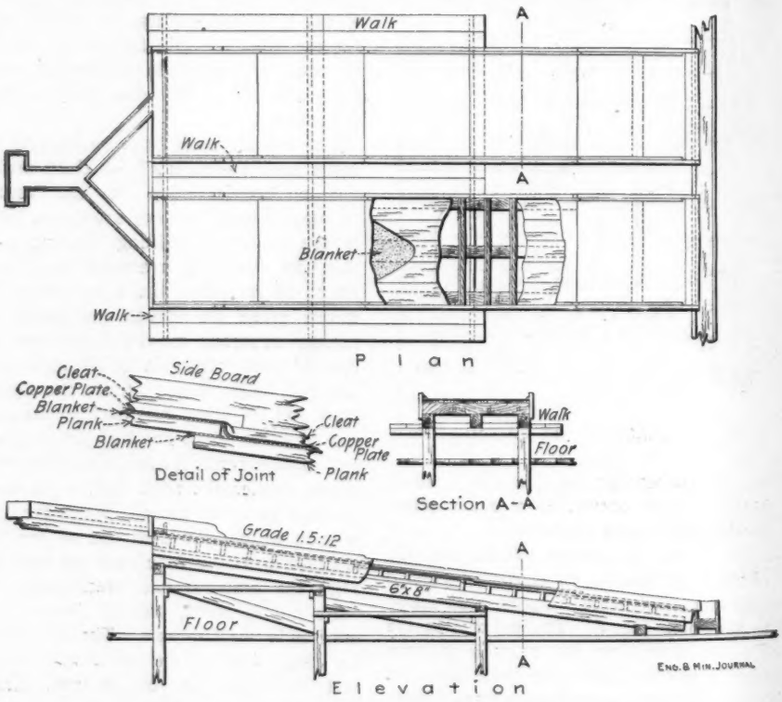
The table shown in the accompanying illustration has been in use in a South American mill for several years and, although it leaked a little when first used, the joints soon swelled and there was no recurrence of the trouble. The plates on this table are 5 ft. wide by 5 ft. 2 in. long. The lower edge of all the five plates is curved downward to a radius of 1½ in., and the upper end of all but the first plate is curved upward at the same radius, but the edge projects only ¾ in. above the surface of the rest of the plate while the projection below the plate at the lower end is 1¼ in. high. The plates are placed in sequence on the table with the curved ends overlapping as shown in the illustration. There is a great difference in the size of the tables used with Huntington mills, a width of four feet is common but five feet is better when the distance between mills is sufficient to allow two such tables being used for each mill. The lengths range from 10 to 30 ft. or more.

The 1½-in. flooring is laid upon 2x4-in. cross-pieces spaced a little more than a foot apart. The flooring for one plate extends a distance of six inches beyond and under the edge of the flooring for the next plate above. The joint can be made water-tight by inserting a thin piece of blanket or flannel and covering the surfaces of the boards with marine glue. Blanket or flannel is laid over the flooring and brought up over the side boards before placing the plates on the table. The plates are held in place by side cleats 1 in. wide. After the cleats are nailed in place the blanket projecting above is cut off flush with the upper edge. It is also the practice in some mills to use a narrow strip of blanket between the cleat and the plate.

Leakage is most apt to occur at the joints between two plates where the curved ends overlap. This joint may be made water-tight by laying a strand of ball wicking, soaked in marine glue if desired, between the two projections before bringing them tightly together. The remaining details of construction are shown in the drawing.

It is a great advantage to use two tables in front of each mill, the pulp being conveyed to the distributing troughs at the head of each table by a split launder, as shown in the drawings. Then at clean-up time it is not necessary to stop the mill and the pulp can be shut off from one table by inserting a board in cleats nailed to the side of the launder just below the split as indicated by the dotted lines in the drawing.

If the floor of the mill is flat, as it often is when Huntington mills are used so that the driving gear will be above the floor, short running boards along the sides of the tables are necessary in order that the platemen can reach over the tables when dressing the plates. The plates are dressed working from the bottom upward as often as required.



AMALGAMATION TABLES FOR HUNTINGTON MILLS

The marine glue mentioned may be obtained from any ship chandler or can be made by dissolving 1 part india rubber in crude benzine and mixing with 2 parts shellac by the aid of heat. This glue should be applied while warm; it sets quickly upon cooling, is slightly flexible and waterproof.

A basic lining for copper converting that has given good results at one smeltery is formed by putting in ordinary magnesite brick and cementing with a paste made by mixing finely ground magnesite with 20% sodium-silicate solution.

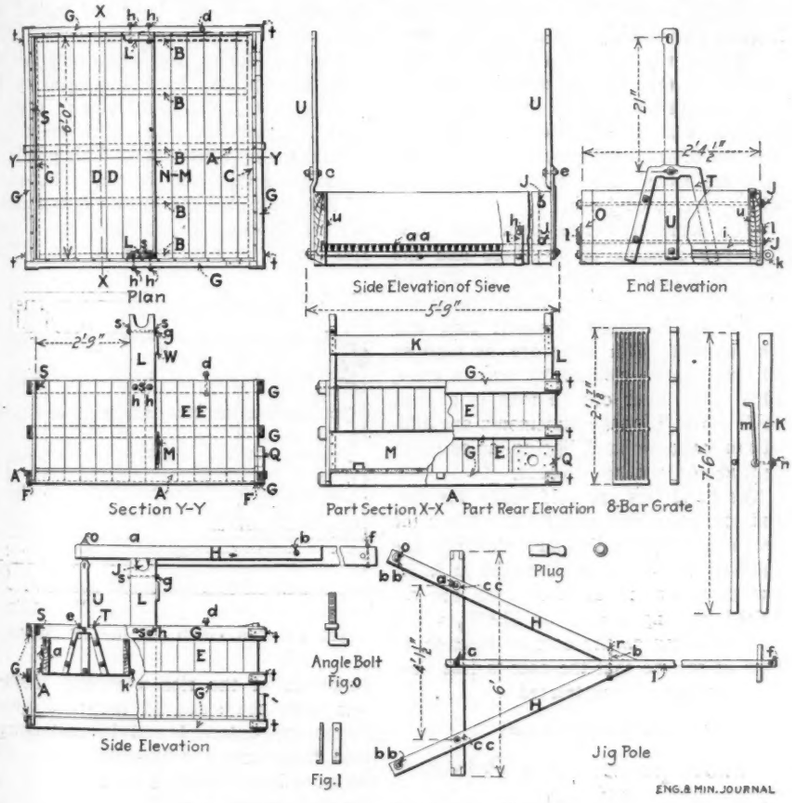
Joplin Hand Jig

The accompanying drawing shows the details of the design of the hand jigs used in the Joplin district of Missouri, where hand jigs are still used, although not so much as formerly. The drawing is self-explanatory. In the accompanying table is given a bill of the materials required for building one of these hand jigs. In the first column of the table, letters are given referring to the corresponding parts on the drawing.

The sieves are approximately 5½ ft. long, 2 ft. wide and 10 in. deep. They are suspended from the jig pole by strap-iron swings, connected through a slot to the jig-pole frame by angle bolts, and when new have ¼-in. play up and down, but as this link wears the play increases to ½ or ¾ in. This is desirable as it makes a quick suction stroke and a slight pause between the pulsion and the suction strokes. The jig pole, which is a 2x6-in. plank 20 ft. long, is provided with a bolt at the end to keep it from splitting. In jigging, the man, who stands on a spring board, grasps the cross bolt that goes through the jig pole as a handle. This spring board is arranged so that the bolt comes about waist-high while he is jigging. Before beginning to jig, the bed is settled and evened by a few vigorous up and down strokes with the sieve well submerged. Then the jigging proper begins with its peculiar short stroke, which is made much easier on the operator by the spring board.

The box of the jig is about 2 ft. 4 in. deep, 5½ ft. wide and 6 ft. long, perpendicular to the screen. The screen cradle is carried by two uprights that come up about in the middle of the side walls of the tank. The jig box is divided into two parts by a baffle-board across the center about 12 in. high, so as to confine the hutch concentrate under the sieve while providing a quieter compartment for the settling of the finer sizes of concentrate that come through the grates. Notches are cut in the bottom of the partition or baffle-board, so as to permit the water to drain out from the hutch part proper when the tank is emptied of the jigging water that has become too dirty for further use.

The sieve is generally lined with No. 16 sheet iron, although sometimes this lining is as heavy as No. 12. A lever with a hook is provided for fastening to the sieve and pulling it out of the way while the hutch product is being cleaned out of the jig. The parts are proportioned so that a rougher-jig sieve filled with a bed about 8 in. thick is about balanced when the bed is submerged. A stroke of about 1 in. is used on the rougher-jigs and one of about ½ in. on the cleaner-jigs, but the stroke is varied according to the ore and the operator.



DETAILS OF A TYPICAL JOPLIN HAND JIG

Grates are used on the sieves with heavy bars, as shown in the drawings. Slots from ⅝ to ¾ in. wide are generally used on the rougher-jigs and from ¼ to ⅜ in. on the cleaner-jigs. A man operating a cleaner-jig has an easy time taking care of the middlings coming from the sieve and the box of two rougher-jigs. Usually three men will treat 15 to 20 tons of ore on two roughers and one cleaner in a 10-hour shift, provided the ore is favorable to hand jigging. Ore suitable for hand jigging must be comparatively free from clay and the metallic minerals not too intimately associated with the gangue. The middlings are saved and re-treated in mills, while often the tailings are run over again in a mill at some later period in the history of the mine.

At Granby, because mining has been going on for years and the workings are comparatively shallow and have been well drained, the silicate ore is not as wet and muddy as is characteristic of the ordinary silicate and lead gouges, as these workings are rightly called in the district. Ordinarily the ore, before being sent to the hand jigs, has to be washed free from this mud and clay, so as to facilitate the hand sorting of the coarser sizes as well as to aid in the hand jigging. This washing is done in a sluice box, in which the man wades around and claws the ore around with a shovel and his feet. After being washed, the ore is taken by the cullman, who either screens it through openings from 1 to 1¼ in. wide, or else uses a cull fork having openings about 1⅛ in. wide between tines. With such a cull fork he removes the coarser pieces from the product that goes to the hand jigs. When the ore is coming from a "jack" mine that is later to be equipped with a mill, seldom is there enough mud and clay in the ore to make it pay to sluice the ore before hand jigging.

No bed is used on the rougher-jigs, and each time that the load in the sieve has been properly bedded, the tailings are scraped down to the middlings or "chats"; the chats are then scraped off and saved, then the bed of "jack" or lead is removed, and the sieve loaded again. Consequently, the hutch work has to be re-run to clean it, although on the sieve some clean jack or lead may be made. In case that a lead-jack ore is being jigged, the ore on the sieve is stratified into the following products: Tailings that are first scraped off, jack chats, jack, jack-lead middlings and lead. The jack and jack chats are cleaned on the cleaner-jig apart from the lead products, the two being piled separately and saved until enough have accumulated for final treatment on the cleaner. The clean lead is put into the lead concentrate and the lead-jack middlings piled separately until the time when there is a good thick

bed of lead on the cleaner. The jack is then separated from the lead by stratifying it on top and scraping it off as a high-grade product to be re-run with the other jack products. The bed maintained on the cleaner-jig varies from 2 to 6 in. in thickness, as the operator lets the bed accumulate, loading on more material from the rougher and scraping off the tailings as soon as he has stratified the load properly, until finally the load on the sieve becomes so heavy that he cannot jig it properly. Then he cleans his screen, leaving a bed about 2 in. thick, and begins over again. The shake that he gives the sieve varies with the thickness of the bed on the jig. Owing to the thinness of the bed, the hutch product is not properly cleaned the first time through. Toward the end of the shift the operator of the cleaner has a thick bed on his jig and re-runs the hutch product. Of course, the hutch has to be cleaned every time that the jigman changes from the cleaning of lead to the cleaning of zinc products. Generally, though, there is only a one-mineral separation to be made on the hand jigs. The two-mineral separation is not so common.

BILL OF MATERIAL FOR HAND JIG

Fig.	Number of Pieces	Material
A	1	2x4 in. x 6 ft. 6 in.
B	4	2x4 in. x 5 ft. 8½ in.
C	2	2x4 in. x 6 ft.
D	14	⅛x5½ in. x 6 ft. 6 in. flooring
E	56	⅛x5½ in. x 2 ft. 8 in. flooring
F	4	¼x1 in. x 6 ft. 2½ in.
G	12	2x4 in. x 6 ft. 3½ in.
H	2	4x4 in. x 7 ft. 1½ in.
I	1	2x6 in. x 20 ft.
J	1	4x6 in. x 6 ft.
K	1	2x4 in. x 7 ft. 6 in.
L	2	2x8 in. x 4 ft. 2 in.
M	1	1x12 in. x 6 ft.
N	1	1x6 in. x 6 ft.
O	2	2x12 in. x 5 ft. 6 in.
P	2	2x12 in. x 2 ft. 1 in.
Q	1	2x8 in. x 14 in.
R	1	4x4x10-in. plug
S	1	1x2x6 in.
T	2	Angle irons
U	2	Hanger irons
a	2	⅝x11-in. bolts
b	1	⅝x9-in. bolt
c	1	½x11-in. bolt
d	1	½x6½-in. bolt
e	2	½x1½-in. bolts
f	1	½x6-in. bolt
g	2	½x8-in. bolts
h	4	½x4½-in. bolts
h_1	10	½x2-in. bolts
i	1	½x5 ft. 9 in.-rod
j	4	½x3½-in. rods
k	1	½x31½-in. eye-rod
l	2	1½x⅜x6-in. irons
m	1	½x19-in. eye-hook
n	1	½x5-in. eye-bolt
o	2	½x2-in. angle bolts
p	5	⅛-in. cut washers
r	8	¼-in. cut washers
s	14	⅜-in. cut washers
t	12	Corner irons
u	2	9½-in. x 2 ft. 1-in. No. 16 sieve liners
v	1	10⅝-in. x 5 ft. 4-in. No. 16 sieve liner
w	1	9½-in. x 5 ft. 4½-in. No. 16 sieve liner
4a	8	½-in. cast washers
aa	10	Grates
bb	2	¾-in. cast washers
cc	4	⅜-in. cast washers

Surprisingly clean concentrates are obtained from the hand jigs when the ore is free, as it is called when there is not much true middling going to the jigs, but inasmuch as the ore is not crushed before hand jigging, much fine mineral is locked up in the tailings, and, of course, an efficient saving is not made on the finest of the mineral particles. On account of the inclusion of some of the true middlings in the jack concentrates, these concentrates are generally somewhat lower in grade than they would be from a mill treating the same ore, but owing to the freeness with which the lead particles break from the jack and the gangue, the lead concentrates from the hand jigs are as clean as those from the mill jigs.

Only at the lead gouges and the silicate workings are hand jigs extensively used at present. Spring City and Granby, where silicate ore is mined, are the places where hand jigging is chiefly done at present, although there are several plants near Lehigh and Belleville where the zinc-sulphide ore from the upper runs is quite free-milling. Otherwise the hand jig is generally used as a preliminary operation to treat the ore coming from the development workings in the early life of a mine, so as to make the mine help pay the cost of its development, and the tailings are saved and re-run in the mill which is erected later.

With some ores three men with three jigs, two running as roughers and the third as a cleaner, can clean up 20 tons per shift on most of the hand-jigging ore in the southwestern Missouri zinc and lead district. With some ore, as high as 30 tons can be cleaned by such a crew, while with other ore 15 tons is a good day's work. Tonnage statements are difficult to make on hand jigging, as so much depends on the ore treated.

The hand jigs are sold ready for use, and cost completed about $30. When the ore is given a preliminary sluicing, one cullman at $2.25, one sluiceman at $2.50, and three jigmen at $2.50 each are required, making a total of $12.25, which may be taken as the cost of treating 18 tons of ore, so that the cost is less than 70c. per ton of ore treated.

Horsepower of a Pelton Wheel

The horsepower of a Pelton wheel may be calculated from the following formula, states *Power*:

$$Hp. = 0.00496\, Ecnd^2 \sqrt{h^3}$$

Where

E = Efficiency of the wheel;
c = Coefficient of discharge from nozzle;
n = Number of nozzles of equal diameter;
d = Diameter of jet in inches;
h = Effective head in feet.

Assuming the efficiency E to be 80% and the coefficient $c = 0.9$, the formula will be reduced to

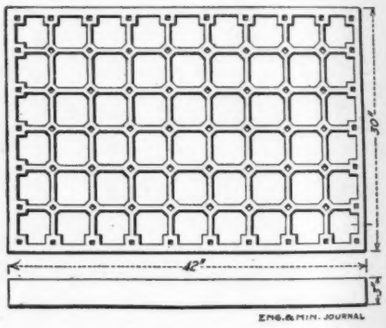
$$Hp. = 0.00357\, nd^2 \sqrt{h^3}$$

Cast-Iron Screen Frames for Jigs

By Claude T. Rice

Grates are generally used to support the bed of ore in the jigs in Joplin mills. They are preferred because the cherty constituents of the ore tend to break into long splinters which choke wire-cloth screens; the grates do not become choked as easily as do screens and when choked can be more easily cleared. However, in certain mills screens are used in some of the jigs, and in order that the jigs may do their work most effectively it is essential that the screen be supported rigidly in a horizontal plane. In many jigs a wooden grating is used for this purpose, the screens being stretched tightly over and tacked to the grate.

Another device for supporting wire-cloth screens has been developed by J. A. Rogers, a Joplin foundryman. It consists of a cast-iron grid, as shown in the accompanying illustration. This grid is a rectangular cast-iron frame, 1 in. wide by 3 in. deep, divided by ribs into a number of lozenge-shaped openings. The ribs are ⅝ in. wide and 3 in. deep. The junctions of the ribs with one another and with the sides of the rectangular frame are enlarged and in casting the grid these enlarged junctions are cored so as to leave holes ½ in. square in the finished casting. At the junctions of the ribs with the frame the sides of these squares are parallel to the sides of the frame while at the junctions of the ribs with one another the diagonals of the square holes are parallel to the sides of the frame. Wooden plugs are driven into these small holes and after the projecting ends have been cut off flush with the top of the ribs the screen is tacked to these plugs.



Jig Grates Used in Joplin Mills

These grids are used in a few mills at Joplin, but because of the splintery nature of the crushed ore screens are used only in a few jigs. In other districts where the ore is not splintery and screens are more extensively used in the jigs these grids might be used to advantage.

Notes from Current Literature

Concerning Mining, Metallurgy and Industrial Chemistry

The Magnetic Bronzes

It was not known before 1903 that alloys of nonmagnetic metals could acquire permanent magnetism, when Heusler discovered this fact (*Metaux et Alliages*, Feb., 1912). The alloys of manganese with aluminum, arsenic, boron, bismuth, antimony and tin become magnetic under the influence of powerful fields, and if copper is present, the magnetism becomes permanent. The alloys are hence usually made by adding the third metal to cupromanganese.

There are many peculiarities of these alloys brought out by heat treatment. For instance, if MnP is warmed in the hand it no longer reacts with a magnet, but does so immediately upon being placed in cold water (Hilpert and Dieckmann, *Proc.* Faraday Soc., Apr. 23, 1912). The critical points seem to be functions of the atomic weight of the third metal, while the magnetic properties themselves seem to be connected in some way with valence. Again, the metals apparently must be in molecular proportions so that the alloy is a mixture of chemical compounds; thus, one series of manganese-copper-aluminum alloys consists of mixtures of Cu_3Al and Mn_3Al.

Influence of Oxygen on Arsenical Copper

The influence of oxygen on copper containing arsenic and antimony was discussed by R. H. Greaves before the Institute of Metals, on Jan. 17, 1912. For rolling, as the percentage of arsenic increases to 0.5%, the percentage of oxygen can be raised to as much as 0.28%, before the material becomes cold-short. If the metal is cold-short from oxygen, arsenic will, up to a certain point, help it. However, the effect of both arsenic and oxygen in wire drawing was detrimental. Increase in oxygen seemed to have no detrimental effect on tensile strength, but produced a marked decrease in elongation.

The addition of arsenic or antimony to pure copper hardens it; the effect of either on copper containing oxygen is first to diminish and then increase its hardness. The addition of oxygen to arsenical copper is without any marked influence on the hardness until it reaches a limit, depending on the percentage of arsenic, when the hardness rapidly increases. Thus copper with 0.4% arsenic and 0.3% oxygen is quite as soft as, if not a little softer than, a similar metal free from oxygen. The limit of the percentage of oxygen which does not noticeably affect the hardness rises to about 0.35% as the arsenic increases to 0.5%. In a similar way antimony first diminishes and afterward increases the hardness of copper containing oxygen, while quite a low percentage of oxygen begins to harden copper containing antimony.

In every case the conductivity of a wire containing oxygen and arsenic was less than one containing no oxygen and equal arsenic, but this effect was reversed with antimony.

Properties of Rare Refractory Materials

An examination was recently made of some infrequently used refractory materials by Fitzgerald and Bennie, and the Norton Co. (*Met. and Chem. Eng.*, Mar. 1912). Alundum (purified and fused bauxite) was found to have a melting point between 2050 and 2100° C. for the white variety, and about 50° lower for the brown; linear coefficients of expansion of 78×10^{-7} and 85×10^{-7} for the two varieties; sp.gr., 3.9 to 4.0; and a high heat conductivity. This latter property makes it useful as a protector for pyrometer couples. The bricks are highly refractory, but in steel furnaces are subject to corrosion from basic fumes arising from the slag.

Crystolon or carborundum (silicon carbide) has a small coefficient of expansion, a higher heat conductivity than alundum, and is extremely infusible. In strongly oxidizing atmospheres it decomposed giving CO_2 and SiO_2, the latter forming a protecting coating on the surface of the brick.

Magnesia has long been regarded with suspicion as a refractory because of its great shrinking on heating. Electrically calcined material is almost free from this fault, and is also apparently unaffected by moist carbon dioxide. Fused lime was also tried, and exhibits some remarkable characteristics. It can be heated to redness and then plunged into water without cracking, and resists moist air and water remarkably well.

Zinc Dust Precipitation

An improvement in zinc-dust precipitation is patented by Charles W. Merrill (U. S. pat. 1,006,865 and 1,006,866), which consists in adding the zinc dust to the unprecipitated liquid in motion, subjecting the emulsion to a grinding action, and filter pressing the resulting mixture. Inferior grades of fume and dust can thus be utilized. The process is applicable to other similar precipitants. The idea of grinding is to remove the coating of oxide on the metallic dust.

The Use of Molten Ferromanganese

In a digest of two articles appearing in *Stahl und Eisen*, the use of solid ferromanganese as a deoxidizer is deprecated by *Echo des Mines*, Apr. 25, 1912. When used either cold or warm in the solid state, it is uneconomical, as small pieces of it do not get through the slag, hence an excess is necessary for complete deoxidation; there is a loss of time if the addition is made after washing the metal; the washing is incomplete if added during this process; and in any event the bath is chilled. Consequently, the procedure used at the Burbach works at Saarbruck, of melting the ferromanganese in an electric furnace in a neutral or reducing atmosphere, is strongly recommended.

Aging Cement with Steam

The Bureau of Standards has been investigating the quick aging of cement blocks, pipe, etc., by exposure to steam, and the following are their conclusions (No. 5, *Technologic Papers*. Bureau of Standards):

Steam up to 80 lb. per sq.in. gage pressure has an accelerating action on the hardening of portland cement mortar and concrete. The compressive strength increases as the steam pressure is increased. The compressive strength increases with the increase in the time of exposure to steam. A compressive strength considerably (in some cases over 100%) in excess of that obtained normally after aging for six months may be obtained in two days by using steam under pressure for curing the mortar. Steam under pressure, if of sufficient duration, permanently accelerates the hardening of the mortar, giving subsequent constant increase in compressive strength with age. The steam-cured mortar or concrete is of much more uniform appearance and much lighter in color than normally aged mortar or concrete made from the same materials. The mortar or concrete should obtain an initial set before it is exposed to the steam treatment. For steam curing a "quak-

ing" or medium consistency is preferable to a dry or a wet consistency. The initial modulus of elasticity and the yield point of the mortar increase directly with the duration of steam treatment. The initial modulus of elasticity and the yield point of the mortar increase directly with the steam pressure. The initial modulus of elasticity does not increase in direct proportion to the increase in the ultimate compressive strength of the steam-cured mortar. Results indicate that the compressive strength obtained by steam curing is directly proportional to the cement content of the mortar.

Saklatwalla Vanadium Extraction Process

A process for the extraction of vanadium from its ores is that of Bryamji D. Saklatwalla (U. S. pat. Nos. 1,020,224; 1,020,312, assigned to the American Vanadium Co.), who treats the ore with acid, preferably dilute sulphuric, and oxidizes the resulting solution with ammonium persulphate, sodium chlorate, or some similar salt, thereby throwing down the hydrated, red oxide of vanadium. Gaseous oxidizers can be used also; for instance, chlorine is said to be advantageous, as the solution from which the vanadium has been precipitated, if used for treatment of further ore, is especially potent in dissolving sulphides. The hydrated, red oxide is then dried, leaving V_2O_5 as a marketable product.

Testing for Radioactive Minerals

That all pitch-black, or clear-yellow ores, which verge upon the green, should be tested for radioactivity, is advised by *Echo des Mines*, Apr. 29, 1912. The test is simple. A photographic plate is placed sensitive side up in a box which can be made light tight, and the mineral to be tested placed upon it. At the end of ten days or so, develop the plate. Black spots and diverging rays of fog show radioactivity. Of course, all precautions taken in ordinary photography to insure an unfogged plate must be taken in this work.

Outlook for the German Potash Industry

That the German potash laws enacted two years ago are not unmixed benefits is claimed in the recently published report of the Aschersleben Potash Mines (*Bull.* Amer. Assoc. of Commerce and Trade, Berlin, May 1, 1912). The struggle to gain a larger quota of the potash sales has resulted in the opening of new shafts at great expense. From 1909 to 1910 the number of mines contributing to the output increased from 55 to 68, and in 1911 was 73. In 1912 the prospects are that there will be 97 mines, and there are now 113 mines sinking shafts, as against 73 in 1911.

It is represented that 10 double mines, such as Aschersleben and Sollstedt, with 30 shafts, would be able to supply the world's consumption of potash. Now, there are more than three times this number, and still others threatened, none of which will probably ever be operated to its capacity. The effect on the potash industry of this sinking of capital, mainly secured by bond issues, in these useless shafts, and of the part-capacity working, is deplored.

Heat Insulating Materials

At the Boston meeting of the American Electrochemical Society, Apr. 18 to 20, 1912, F. A. J. FitzGerald gave a paper on the suitability of various heat insulating materials for checking furnace heat-radiation losses. The materials tested, in the form of bricks, were built into furnaces, heated from the inside by a nichrome resistance wire. The following is the order in which some of the materials tried stand; in order of descending conductivity: Silicon carbide; magnesia; alundum; silica; firebrick; red brick. The above results show why alundum crucibles or muffles should be desirable. The great insulating effect of small quantities of loosely packed coverings was also pointed out.

An Aluminum Disease

It appears that spun, hammered or rolled aluminum is, like tin[1], subject to disease (*Metal Industry*, May, 1912). The disease manifests itself in the same way, by the disintegration of the metal. This is said to be due to different degrees of electric tension in adjoining layers of metal having been set up by strain in the metal, when in the presence of electrolytes. Lime salts especially seem to favor corrosion.

Titanium in the Blast Furnace

The troubles formerly experienced with titanium in the blast furnace were due to excess of flux, says the *Pahasapa Quarterly*, January, 1912. This resulted in forming infusible calcium titanate. If a greatly reduced quantity of flux is used, the titanium is taken up as calcium titano-silicate, which is readily fusible. It is claimed that fusible slags carrying as much as 20% TiO_2 can be made in this way.

Amino White Lead Process

A patent has been taken out in Germany on a new method of making white lead, says the *Oil, Paint and Drug Reporter*. According to the patent, white lead is made by treating litharge or other lead compounds with a boiling solution of amino acids, such as result on hydrolysis of albuminoid substances, and precipitating the lead from the solution by passing through it a current of carbonic-acid gas. As the organic acids remain in solution when the white lead is precipitated, the liquor can be used continuously for dissolving more litharge.

[1]Eng. and Min. Journ., Dec. 31, 1910; Feb. 4, 1911.

French Requirements for Tungsten Ore

A great French steel works demands the following requirements in tungsten ore: It shall titrate a minimum of 60% of tungsten, and a maximum of 5% manganese; it must be practically free from substances which injure steel, such as tin, arsenic, bismuth, zinc, and sulphur; it must be in large pieces (small sizes will be penalized); and the material ought to be in boxes, instead of sacks. Commenting on this *Le Journal des Mines et de la Metallurgie* says that the works in question seems entirely ignorant of mining conditions; for instance, practically all the Colorado output must be in small sizes, as it is a concentrate.

Wet Screening Device

For wet-screening, Enos A. Wall, of Salt Lake City, has patented (U. S. pat. 1,005,907) a screen having a slight inclination, which is thrown forward by a spring against a bumping post, so that the ore will be dislodged and fall on the screen at a lower point, with any cakes so broken as to be subject to action of the wash water. The screen is then slowly retracted against the action of the spring.

Detinning in Italy

There are said to be three detinning plants in Italy: the Dossmann company, at Pegli; the Eugenio Gueco company, at Arenzano, and the Societa Electrochimica Vesuviana at San Giovanni-Tettucio. The first named has been running about five years, says the *Journal du Four Electrique*, Apr. 13, 1912, and treats about 2500 tons of tin scrap per year. The process is the caustic-soda electrolytic.

Tin Ore in Poland

A group of capitalists has been making explorations in the basins of the Sosnowice and Dombrowa, in Poland, to discover tin ore. Tin ore is at present known near Kogroufka, says *Echo des Mines*, Mar. 25, 1912, where the deposits attain a thickness of about 1¼ m. The commercial exploitation of these ores will be undertaken shortly.

Pyrophoric Alloy

A new pyrophoric alloy, said to be cheaper than the cerium-iron alloys, and not subject to disintegration, is: Mn, 80%; Sb, 10%; Cr, 10% (*Brass World*, May, 1912). The alloy is airproof, and is said to produce a long streak of flame, instead of a shower of sparks.

Hydraulicking in Beauce County, Que.

By Fritz Cirkel*

Hydraulicking was tried on Rivière de Loup in 1882, but failed; this method was consequently in disfavor until another company, after two years' investigation, installed a hydraulic plant on the Ruisseau des Meules. A 7½-mile flume was constructed for conveying water from Lake Fortin, which is 335 ft. above the gravel workings; in a trial run last summer the plant worked satisfactorily.

*Consulting mining engineer, 80 Stanley St., Montreal, Que.

The hydraulic exploitation of alluvial gold gravels, in Beauce County, was first attempted in 1882, when the Gold Mining Association of Canada, under the management of A. F. Humphrey, installed a hydraulic plant on the banks of the Rivière de Loup. This plant consisted of a ditch 11½ miles long, to tap the waters of that river, the necessary steel pipes, giants and all accessories; 215 ft. of head was obtained; the quantity of water supplied to a 4½-in. nozzle amounted to about 350 miners' inches, and the capacity of the plant to about 1000 cu.yd. per day of 24 hours. The thickness of the pay dirt varied from 30 to 40 ft., yielding, so it is reported, on an average of 10c. per cubic yard.

Hydraulicking Abandoned in 1884

The company operated during the seasons 1882 and 1883, but abandoned the works in 1884, after having spent upward of $150,000. The suspension of operations of this concern was a serious set-back to gold mining in that section of the country, and the failure to work the gravel banks by means of hydraulicking is responsible for the continuation of the old primitive mining method, that is, by pick and shovel.

From a closer examination of the gold deposits along the shore of the Rivière de Loup, it appears that at the points where they were worked, the richer portions are concentrated near bedrock, and as the latter was much below the actual river bed, it is obvious that the hydraulic method would fail unless the course of the river was changed altogether. After the experience of the Canada Gold Mining Association, the hydraulic method was considered unsuitable to the working of the Beauce River banks, and this is the principal reason why no further attempt at hydraulicking was made in later years.

The extensive investigations, however, carried on by the Champs d'Or Rigaud Vaudreuil for the last 2½ years, over the greater part of the Seigneurie Rigaud de Vaudreuil, conclusively prove that there are stretches of gold-bearing ground along certain river beds, which, by reason of their favorable situation, richness and water facilities, are well suited for the successful application of the hydraulic process.

Of course, it must be admitted that in some cases it is not easy to determine offhand whether the hydraulic method can be successfully applied; it takes a serious study primarily as to water conditions and further as to the conditions governing the distribution of the gold in the alluvials; a mistake made in either one of them means the loss of considerable capital, especially in cases where a long ditch has to be built for the conveyance of the water to the works.

New Company Prospected Thoroughly

First of all, the investigations regarding the situation, character and tenor of the alluvial gold deposits have to be carried on systematically either by shafts in connection with underground work to some extent, and also by drilling. This latter method has been advocated as the only proper means for the exploration of these gold fields by mining engineers for many years. Although I was the first to introduce the method in that district, I am rather skeptical regarding the all-around application of this method in preference to shaft sinking.

Two kinds of drills were employed, the Empire hand drill and the Keystone power drill. Several hundred holes were put down in different sections of the seigneury, and while it must be admitted that, on the average, good results were obtained as far as the cost per foot was concerned, the fact must not be lost sight of that testing by shafts enables one to study the character of the gold alluvials to far greater advantage than by drill holes. Again, where the ground is extremely bouldery, the progress of drilling is slow, and it often happens that explosives have to be resorted to in order to get rid of the impeding boulders. One important point, however, in favor of the drills is that there is a possibility of penetrating to bedrock in places where much water and quicksand are encountered. In these cases, either hand or power drills are indispensable, and there is today no other efficient method to replace them.

Cutting and Driving Giants at Work on the Ruisseau des Meules Gravels. Mechanical Elevator in Background

Both Shafts and Drills Used

To perform the exploration of a given strip of land efficiently, it is necessary to divide the surface into squares, if possible, all of the same dimensions, and test each square by a certain number of shafts and drill holes. On the northeast branch of the Gilbert River and along the lower part of the latter on Lots 9 and 10, St. Charles, a checkerboard system of drill holes and shafts was brought down, the total length of the ground to be tested in both cases being about 1000 ft. long, its width from 100 to 300 ft., all divided into squares of 50 ft. each.

As a concrete result of the varied exploration work carried on in different sections of the seigneury, it must be said that it is far more advantageous to sink shafts than to drill holes in ground which

is known to contain boulders; in ground comparatively devoid of these or containing quicksand, the drilling method is preferable.

In the selection of the ground tested previously by drilling or shaft sinking for the hydraulic method as outlined above, it must be stated that certain fundamental principles underlie the successful exploitation of the alluvials, viz.: (1) the water facilities, (2) the head to be obtained, (3) the grade of the river bed. After a thorough investigation of all these factors, the Champs d'Or Rigaud Vaudreuil, Ltd., decided to place hydraulic equipment on the lower banks of the Ruisseau des Meules, a small stream draining considerable territory on the left bank of the Chaudière River, south of Beauceville.

Water Supply a Problem

The difficulty of obtaining the necessary quantities of water was, at the beginning, not easily overcome; having an abundant supply of water all the year round in the Chaudière River, the idea suggested itself at first to build a ditch from some suitable point between the towns of St. Georges and Beauceville and to pump the water from the river into this ditch, but after careful consideration this project was abandoned. It must be stated here also that C. W. Purington, of the U. S. Geological Survey, reports that out of nine plants visited by him in Alaska and in Canadian territory, at which pumping to secure head for hydraulic mining was in progress, not one of them was making expenses.

Accordingly a search for other sources was made, and it was soon established that there were a number of lakes about seven miles to the southwest, which, by reason of their elevation and quantity of water stored in them, would likely solve the difficulty. The largest of these lakes, Fortin Lake, at St. Victor, Tring Township, covers an area of 381 acres. Its elevation above sea level is 1020 ft., above the point on Ruisseau des Meules, where the plant was to be established, 335 ft., and its distance 7½ miles. This lake, which was selected as the main reservoir for the hydraulic plant, is fed by Lake Castor, at an elevation of 60 ft. above Lake Fortin. In order to store the water in Lake Castor for the summer, to be used as needed, a dam was built 320 ft. long, 6 ft. above normal level, and the intake of the ditch placed at 3 ft. below the lake level; this makes a water column of 9 ft., and based upon the area of the lake at normal water level, that is, 36.5 acres, and taking the gently sloping condition of the land immediately surrounding the lake into consideration, it is safe to assume that about 30,000,000 cu.ft. of water can be stored for immediate use.

Lake Fortin Main Reservoir

In Lake Fortin, a dam, 6 ft. above normal lake level and 650 ft. long, keeps all the water back resulting from the early spring freshets. The bottom of the intake of the long ditch is 5 ft. 2 in. below the normal level, thus forming with the 6-ft. dam, a water column of 11 ft. 2 in. It is calculated that together with the unavoidable overflow and the water stored in Lake Castor, about 250,000,000 cu.ft. of water can be obtained, which, at a daily consumption of 1100 miners' inches, will keep the plant going from 4½ to 5½ months, depending, of course, greatly upon meteorological conditions.

The main point in favor of Lake Fortin as the main water reservoir was its satisfactory elevation to cover the greatest range of mining ground at the smallest expense with a great hydraulic pressure. For the first 3200 ft. near the lake, the ditch has a grade of 1 ft. to every 800 ft., and for the balance, that is, for a length of 6¼ miles, 1 ft. to every 600 ft., leaving thus a net head pressure for the giants of 275 feet.

Construction of Ditch

The most difficult section in the construction of the ditch was that part lying nearest to Lake Fortin, covering a distance of about 3200 ft. Most of this section had to be cut through solid rock, the deepest cut being about 30 ft. at a distance of 900 ft. from the lake. The timbering of this cut consists of two posts 8 ft. square and caps and sills to match, the inside measurements being: 30 in. under cap, 40 in. above sill between posts, and 64 in. between cap and sill; these sets are placed every 4 ft. For the protection of the timber against ice, snow and heat, it is covered with several feet of earth. Manholes for the inspection of the ditch are installed every 1000 feet.

The remainder of the ditch measures 3 ft. at the bottom, 6 ft. at the top, is from 2½ to 3 ft. deep, and is timbered where necessary; it is calculated that with a velocity of 4.1 ft. per second, the ditch will carry 2000 miners' inches. The flumes, 16 in number, and measuring 5600 ft. in length, are 4 ft. wide and 3 ft. 6 in. high, having approximately the same areal sections as the ditch; the longest stretch of flume is 1050 ft. The ditch empties into the pressure box or penstock, a large wooden box, from whence the water is conveyed by a pipeline down to the works. Connected with the penstock is the sand or refuse box, which is placed below the ditch line to catch all sands, and also a grating of bars to retain all floating substances.

The pipeline, made of wrought iron in sections of 8 ft., from the pressure box to the works, has a length of 2600 ft., and to the end of the sluice box, 3450 ft. The diameter of the first 1600 ft. is 18 in., with No. 18 gage plate; for the next 800 ft., 15 in., with No. 16 gage plate; the pipe line for the cutting and driving giants is 15 in., with No. 14 gage; and for the stacker, 10 in., with No. 12 gage plate. Gates are installed all along the line, the main gate being in the upper part of the pipeline, and the others on all the branches. Air valves are installed every 100 ft. with apertures of 2x4 in. For the supply of the mechanical elevator and the Pelton wheel of the derrick, 4-in. branches are used. Three giants are installed: two for cutting and driving, and the third one for stacking at the end of the sluice box.

Penstock at End of Flume from Lake Fortin in Beauce County, Que.

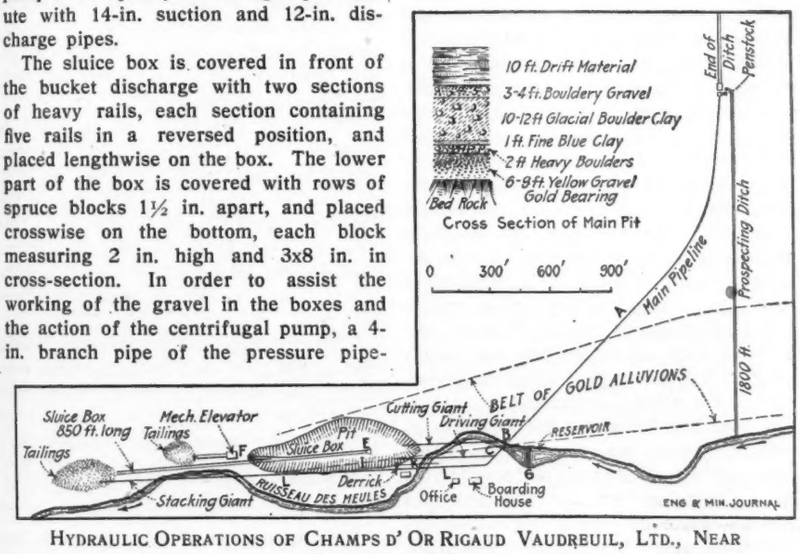
The main sluice box is 850 ft. long, and is composed of sections of 12 ft., each having a grade of 3½ in. It is 3 ft. wide, 3 ft. 6 in. high, the sides being made of 1½-in. planks, with 4x6-in. posts. The bottom, made of 2-in. planks, is covered with sections of five rails, each 4 in. high, and 20 ft. long, placed lengthwise in the box and in a reversed position. The rails facilitate the trans-

port of the gravel a great deal, and retain between them the gold in a highly satisfactory manner.

Mechanical Elevator Used

The mechanical elevator, a compact steel structure, lifts 23 buckets of 3 cu.ft. each per minute, which is equivalent to a capacity of 3672 cu.yd. per 24 hours, and is mounted on two trucks of a 20-ft. gage track resting on bedrock. There are 48 buckets mounted on a ladder which can be lowered or raised by an electric hoist with steel cables and shackle blocks; they are operated round an upper and lower tumbler and an idler placed half way up the ladder. The material lifted by the buckets is dumped into the upper sluice box and is here washed by means of a flow of water thrown from a powerful centrifugal pump of a capacity of 4500 gal. per minute with 14-in. suction and 12-in. discharge pipes.

The sluice box is covered in front of the bucket discharge with two sections of heavy rails, each section containing five rails in a reversed position, and placed lengthwise on the box. The lower part of the box is covered with rows of spruce blocks 1½ in. apart, and placed crosswise on the bottom, each block measuring 2 in. high and 3x8 in. in cross-section. In order to assist the working of the gravel in the boxes and the action of the centrifugal pump, a 4-in. branch pipe of the pressure pipe-



Hydraulic Operations of Champs d'Or Rigaud Vaudreuil, Ltd., Near Beauceville, Que.

line throws water into the discharge pipe of the pump immediately under the discharge box of the buckets.

The Plan of Operation

The general plan of operation was to convey the water from Lake Fortin to the top of a hill close to the works, and pipe it from there to the alluvions 275 ft. below. The grade of the river bed, 2.35%, not being sufficient to dispose conveniently of the tailings without an extra giant, it was decided to install a mechanical elevator, by means of which the tailings were to be raised and stacked in the manner indicated in one of the halftones.

A sketch plan of the operation, as carried out during the summer of 1911, is presented in the accompanying engraving. One main pipeline *A* is laid to a point 1000 ft. from the works; it then branches out in two smaller lines for the cutting and driving giants *B* and *C*. The gravel bank is attacked by the cutting giant *B* and the loosened gravel driven by giant *C* into a sluice box *E*, where all the coarse and some of the fine gold are retained. The tailings are then elevated by a string of buckets in the mechanical elevator *F;* the remainder of the fine gold is retained in the upper sluice boxes of the latter, and the tailings disposed of as indicated.

The overflow of the pressure box or penstock in case some of the giants are stopped is utilized for prospecting purposes; all the water is led in ditch *H* over a hill which forms the continuation of the gravel bank, now under exploitation. After two months' flow over a stretch of 1800 ft., the water had cut into the bank in some places as deep as 18 ft., and had laid bare in this way a stretch of gold-bearing alluvions of over 200 ft. wide. All this overflow water is again collected in a reservoir *G*, and used in connection with the driving giant in such a manner that whenever the gravel is driven into the sluice boxes the gates of the reservoir are opened full, the outrushing water facilitating greatly the conveyance of the gravel through the boxes to the elevator. It was found that by these means the efficiency of the plant was increased fully 40 per cent.

Derrick for Removing Boulders

For the extraction of boulders from the gravel a hydraulic derrick *I* is used; this is placed at a convenient point near the gravel pit and is driven by a Pelton water wheel operated through high-pressure water from a 4-in. branch pipe *K* of the main pipeline. Since the water supply has been greatly increased through enlargement of the ditch and other improvements, experiments have shown that all the tailings instead of being elevated through a costly mechanical operation, can be disposed of conveniently by hydraulic stacking.

A sluice box was built 850 ft. long, one end being brought right up to the gravel banks, while the other landed in the river valley below the elevator. The tailings accumulating at the end of the sluice box were stacked to the side of the valley by a giant with a 4-in. nozzle, fed by an 8-in. pipe *L* from the main line as indicated in the diagram. The long sluice box is also connected, as shown in the diagram, with the mechanical elevator; this serves as an emergency in case the water pressure is low or the stacking of the tailings by hydraulicking is interrupted for any reason.

The hydraulic plant was worked principally for experimental purposes during part of the summer of 1911. The main trouble in starting it right was in the adjustment of the operating units of the elevator, deepening of the sump, changes at the discharge end of the buckets, trouble with the electric transmissions and motors; but once these difficulties were overcome, the whole plant worked satisfactorily under prevailing conditions.

In the beginning of the season, when the mechanical elevator was operated, only one giant using 520 miners' inches was used. Three 8-hour shifts were run in 24 hours, Sunday and holidays alike, about two-thirds of the time being used for hydraulicking, and the other third for the removal of boulders by derricking. The fact, however, that owing to the insufficient water supply, only one giant could be operated, which was used for both cutting and driving purposes, mitigated against the efficient handling of the whole plant, and it was soon recognized that unless the quantity of water was increased to such an extent that two giants could be used simultaneously for cutting and driving, the plant could not be economically operated.

Consequently, as soon as Fortin Lake had dispensed its surplus water, the problem of increasing this water supply was seriously attacked, and within 2½ months after the suspension of hydraulicking, the whole ditch and flume line, seven miles long, as well as the intake on Fortin Lake, was thoroughly overhauled, enlarged, many places deepened, leakages stopped, and the grades adjusted; and on Nov. 5, 1911, for the first time, two giants could be used simultaneously in connection with the 850-ft. sluice box in the handling of the gravel banks.

Capacity 2500 Cu.Yd. Daily

Owing to the advance of the winter season, however, the plant had to be shut down after only two weeks of operation, but at the outset it was recognized that during this short time the pay dirt could be handled for just half the cost as when operated under the old system. The capacity of the plant as it stands today is about 2500 cu.yd. per day of 24 hours,

and this might possibly be increased through additional alterations and improvements now contemplated, and to be made after the season's work is finished.

A general description of the physical features and the geology of the country was given in my paper[1], "Alluvial Gold Deposits in Quebec." Those interested are referred to that article. A cross-section is shown of the main bank, which now forms the subject of extensive exploitation by means of this new hydraulicking plant. These alluvions in more or less variation constitute, so far as present knowledge through exploration work goes, the valley and banks along the Ruisseau des Meules, commencing from the confluence with the Chaudiere River and extending to a point about three miles further up the creek. The present hydraulicking machinery is situated about half way, the plan having been adopted to ascend gradually the valley and fill the remaining spaces with the débris and tailings of the washed pay dirt.

Extensive Deposits Available

It is estimated that there are available for immediate exploitation in the vicinity of 3,000,000 cu.yd. of pay dirt, not counting the extensive stretches along the upper part of the creek, where many indications point to the continuation of the alluvial deposits. A part of this ground, especially where the plant is now situated, constitutes the tailings from earlier washings on a small scale, and an idea may be gained from the tenor of the ground when it is stated that at the first trial cleanup, on July 5 and 6, 1911, 37c. per cu.yd. was obtained from a lot of 2600 yards of tailings. A second cleanup, on Aug. 15 and 16, from 16,600 cu.yd. composed partly of tailings and partly of virgin ground, gave 42c. per yard.

The width of pay alluvions immediately in front of the elevator is 90 ft.; at 300 ft. distance it is 165 ft., and at 1800 ft. from the elevator, as far as the exploration in the overflow ditch shows, about 400 ft. Most of the gold is found close to bedrock, which is composed of slate and schist, or in crevices of the latter. The strike of this formation is the same as the general trend of the river valley, namely, 63° northeast. All the big nuggets found so far on this property were taken from the bedrock or from gravel immediately overlying it, the latter having a thickness of from 3 to 9 ft. The largest nugget found at the last cleanup had a value of $292.50; other nuggets found at the same time represented the following values: $171.60, $98.47, $76.93, $43.39, $35.22, $30.17 and $18.16.

Electric Power for Elevator

The power house for the operation of the mechanical elevator plant is situated on the track of the Quebec Central Ry., about 1000 ft. from Beauceville Station, and contains one 200-hp. engine with 15-ft. flywheel of the Jerome Wheelock system (diameter, 17 in., stroke, 28 in., speed, 94 r.p.m.), with condenser, two 100-hp. Goldie & McCullogh tubular boilers with forced-draft system, one Allis-Chalmers-Bullock three-phase, 60-cycle, 150-kw. generator (900 r.p.m.), and all other accessories incidental to the proper operation of a plant of this class.

The current at 2300 volts is carried by a transmission line 1½ miles long to the mechanical elevator. It is transformed to 440 volts for the electric-lighting plant, which consists of three arc lights and numerous incandescent lights all over the premises. A 50-hp. motor for the operation of the 48 buckets, and a 150-hp. motor for the operation of the big 4500-gal. pump, are installed within the steel structure of the mechanical elevator.

There being no feed water for the boilers of the power plant in its immediate vicinity, a creek one mile distant had to be utilized by damming same and conveying the water down a mountain slope to the plant. The pipe line consists of two sections: The upper one, 2700 ft. long, consisting of 2-in.; and the lower one, 2600 ft. long, of 1½-in. galvanized-iron pipe. The intake is 270 ft. above the power plant, so that the water is delivered to the latter under a pressure of 122.7 lb. A regular telephone system is installed all along the transmission line and the ditch up to the lake, or over a total of 8½ miles, facilitating the operation of the plant a great deal.

A boarding house for the accommodation of 40 men; an office and manager's lodgings; a machine shop and storehouses at the diggings on the Ruisseau des Meules, make up the remainder of this interesting plant. The hydraulic part of the plant was projected and installed with the assistance of California miners, who had more than 20 years' experience in hydraulicking in Siskiyou County, Calif. Much of the success of the enterprise so far recorded is due to the foresight of these men and to the practical manner in which this difficult operation was handled from the start.

[1]Eng. and Min. Journ., Nov. 25, 1911.

Associated Oil Co., California

The Associated Oil Co., of California, according to the 10th annual report, made a profit in 1911 of $1,766,246. The gross earnings, after deducting operating expenses, maintenance and transportation, were $4,172,215. Interest on bonds, $687,754; depreciation reserve, reinvestment, including sinking fund for retirement of outstanding bonds, $1,718,215. The statement includes the activities of the Associated and its proprietary companies, as well as dividends from affiliated companies. The proprietary companies include the Associated Transportation Co., Associated Supply Co., and Bakersfield Iron Works. The following named are the affiliated companies: Pioneer-Midway Consolidated, Sterling Oil & Development, West Coast, California Coast, Amalgamated, Salt Lake and Arcturus. Of these the last three are on a dividend basis, having paid a total of $576,000 during the period.

British Iron and Steel Production

The British Iron Trade Association reports the production of pig iron for the calendar years 1910 and 1911 as follows, in long tons:

	1910	1911	Changes
First half	4,993,745	5,110,823	I. 117,078
Second half	5,223,000	4,607,815	D. 615,185
Year	10,216,745	9,718,638	D. 498,107

As compared with 1909, the make in 1911 showed an increase of 54,351 tons. It will be seen that there was a considerable drop in production during the second half of last year, while in 1910 the opposite condition prevailed.

The total production of wrought or puddled iron in 1911 was 1,191,499 tons, which compares with 1,118,893 in 1910, showing an increase of 72,606 tons. The increase over 1909 was 62,087 tons. This production in 1911 was the largest reported since 1899, when the total was 1,210,609 tons, or 10,110 tons more than last year.

The production of steel ingots, unlike that of pig iron, showed an increase over 1910. The total make was, in long tons:

	1910		1911	
	Tons	%	Tons	%
Bessemer	1,779,115	28.0	1,461,140	22.6
Open hearth	4,595,366	72.0	5,000,472	77.4
Total	6,374,481	100.0	6,461,612	100.0

This statement shows a decrease last year, as compared with 1910, of 317,975 tons in converter steel, but an increase of 405,106 tons in openhearth; the total increase being 87,131 tons. The make of openhearth ingots last year was the largest ever reported in Great Britain, the highest figure previously recorded being in 1907, when the total was 4,663,489 tons. Converter steel make has been exceeded in a number of previous years.

The division into acid and basic steel in 1911 was:

	Acid		Basic	
	Tons	%	Tons	%
Converter	887,767	13.7	573,373	8.9
Openhearth	3,131,218	48.5	1,869,254	28.9
Total	4,018,985	62.2	2,442,627	37.8
Total, 1910	4,154,933	65.2	2,219,548	34.8

The larger part of the increase in the make in 1911 was in basic openhearth steel.

Representative Kahn, of California, has introduced a bill by which lands chiefly valuable for asbestos may be patented under the provisions of the laws relating to placer mineral claims.

Mass Action and Reaction Velocity

By Harry C. Jones *

A further discussion of the influence of mass on reaction velocity and chemical equilibrium. This is of great consequence to the metallurgist in the reduction of metallic oxides, and to the technical chemist as determining the possibilities of many of his reactions.

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We can now deal with chemical reactions in a far more scientific manner than in the past, due to the recent developments in physical and general chemistry; and these developments have centered around the generalizations already discussed in these papers.

The measurements of the heat changes that always manifest themselves whenever a chemical reaction takes place, and which condition the chemical reaction, led Berthelot to the conclusion that that chemical reaction will take place which evolves the largest amount of heat. There are exceptions known to this generalization, but it contains a large element of truth, and most chemical reactions conform to it.

Most chemical reactions evolve heat or are, as we say, exothermic. The effect of rise in temperature is to oppose that reaction which takes place with evolution of heat, and the products of exothermic reactions are less and less stable the higher the temperature to which they are subjected. The principle is, that the addition of heat opposes the formation of those substances, whose formation involves the evolution of heat; and rise in temperature renders such substances less stable.

The converse is also true. A reaction which absorbs heat is known as endothermic. The addition of heat favors the formation of a reaction which absorbs heat, and in general renders the products of such a reaction more stable.

Heat Changes Determine Even Reaction Direction

The importance of the heat changes, and the effect of mass or quantity as conditioning not simply the velocities of chemical reactions, but even their direction, is now realized not only by the man of science, but by the engineer in the industries. Whether any given reaction will or will not take place is often conditioned solely by one or the other of these factors.

This is well illustrated by the example cited by Bodländer in *Zeitschrift für Elektrochemie*, VIII, 838 (1902). It is there pointed out that the reducing action of carbon can take place in terms of any one of the three equations, and with the following evolutions of heat:

I $C + 2O = CO_2 + 97{,}650$ calories
II $CO + O = CO_2 + 68{,}000$ "
III $C + O = CO + 29{,}650$ "

This explains why carbon monoxide (CO) is often a better reducing agent than carbon (C), since, for a given amount of oxygen taken from say an oxide, more heat is evolved—48,825 cal. is less than 68,000 cal.

We can also, in the light of these facts, see the meaning of the following facts. It should be stated first, that the amount of heat liberated in the formation of any given chemical compound is a fair, general criterion of the stability of the compound. A moment's thought will show that this is true. The heat liberated in the reaction comes from the intrinsic energy of the substances that react. The more heat liberated the more intrinsic energy of the initial substances is lost as intrinsic energy.

This is the same thing as to say that the resulting products contain less intrinsic energy the greater the heat evolution of the reaction. Chemical stability varies inversely as the amount of intrinsic energy present. The more intrinsic energy present in a substance, the more reactive it is chemically, that is to say the more unstable it is. Water is so stable because it contains relatively little intrinsic energy; shown qualitatively by the enormous amount of heat liberated in its formation—this being the most exothermic of all chemical reactions known to man.

The Reduction of Oxides

The heat of formation of zinc oxide, and, therefore, its energy of formation at absolute zero is 85,800 cal. If this energy of formation persisted at higher temperatures, it could not be reduced either by carbon or by carbon monoxide since they have less energy of formation.

While zinc oxide is not reduced by carbon at 1100° C., it is appreciably reduced at 1125° by carbon, showing that its energy of formation at this temperature is equal to that of carbon monoxide when formed from carbon and oxygen= 29,650 calories.

When zinc oxide is reduced by carbon monoxide, this will take place only until the carbon dioxide present reaches a certain concentration. Thus, at 1000° carbon monoxide would reduce zinc oxide only until the concentration or mass of the carbon dioxide reached 0.1%. At a temperature of 1125° the concentration of the carbon dioxide can be 0.2% before the reduction of the zinc oxide by carbon monoxide ceases, and at 1500° the carbon dioxide can have a concentration of 0.76% before equilibrium is reached.

If the concentration or mass of the carbon dioxide is greater than that mentioned above at the temperature in question, then the reverse reaction takes place; zinc being converted into the oxide. We are obviously dealing here with a typical reversible reaction, and this leads us to consider more fully the nature and meaning of such reactions.

Velocity and Equilibrium of Chemical Reactions

The meaning of reaction velocity, chemical equilibrium and reversible reactions was referred to in the introductory chapter which dealt with the discovery of the law of mass action. These must be discussed here a little more fully, or at least more exactly.

Given a reaction in which two substances disappear, and in which everything is in solution before the reaction and everything remains in solution after the reaction is over. How would we calculate the velocity of such a reaction? If we represent the mass of one of the substances present by x and the mass of the other substance by y, the velocity of the reaction is the amount of transformation in a given time. If s is transformed in time t, we have

$$\frac{ds}{dt} = K(x - s)(y - s)$$

in which K is a constant whose value depends upon the nature of the substances reacting.

If we use equivalent quantities $x = y$, the above expression becomes,

$$\frac{ds}{dt} = K(x - s)^2$$

which, on integration, gives—

$$\frac{1}{x - s} = Ct + const.$$

and this is the expression for the velocity of such a reaction, which, since two substances are involved, is a second order reaction; and since everything is in the same state of aggregation, is a homogeneous reaction.

How do we calculate the condition of equilibrium in a second order, homogeneous reaction? Equilibrium, it will be recalled, is that condition of a reversible reaction where the two opposite reactions have the same velocity.

The velocity of a second order homogeneous reaction, is, as we have just seen, expressed thus—

$$\frac{ds}{dt} = K(x - s)(y - s)$$

in which x and y are the two initial substances that react. The second reaction takes place between the products of the initial reaction x_1 and y_1, and since $s_1 = -s$, and $ds_1 = -ds$, has the velocity—

$$\frac{ds_1}{dt} = K_1 (x_1 + s)(y_1 + s)$$

At equilibrium the two opposite velocities are equal—

$$K (x - s)(y - s) = K_1 (x_1 + s)(y_1 + s)$$

or

$$\frac{K}{K_1} = \frac{(x_1 + s)(y_1 + s)}{(x - s)(y - s)}$$

and this is the condition of equilibrium in a second order, homogeneous reaction.

By methods analagous to the above the velocities and equilibria of reactions of almost all known orders can be calculated. Here again space will not permit of any further detail. Any one who is interested can find these matters discussed at some length in my "Elements of Physical Chemistry," pp. 526 to 600.

Catalysis

There are few subjects more to the front both in science and the industries than catalysis. Just what do we mean by a catalyzer? We mean a substance that affects the velocity of a reaction without itself entering into the reaction. The effect may be an acceleration or a retardation of the velocity of the reaction in question, but is usually an acceleration. The great technical problem is often to find a substance that will increase the velocity of a given chemical reaction, without itself being "used up" as it is said: i.e., without itself entering into the reaction in question.

This was the definition that was given a catalyzer by the discoverer of catalysis, the great Swedish chemist Berzelius, and the definition holds as well to-day as when it was proposed nearly a century ago. The finely divided metals, many of the metal oxides, the metals at high temperatures, hydrogen and hydroxyl ions are among the more common catalyzers.

The hydrogen ions are very good catalyzers indeed. The inversion of cane sugar by acids is due to the catalyzing action of the hydrogen ions. The hydrogen ions do not enter into the reaction—no acid is used up—and yet the velocity of the inversion is proportional to the number of hydrogen ions present. The cane-sugar molecule in the presence of hydrogen ions takes up a molecule of water and breaks down into glucose and fructose. Similarly, hydrogen ions cause an ester to take up water and break down into the corresponding organic acid and alcohol, without themselves entering into the reaction.

Dioxides as Catalyzers

The action of manganese dioxide on hydrogen peroxide in neutral solution breaking it down into water and oxygen is an example of the catalytic action of the dioxides. In neutral solution the manganese dioxide remains unchanged. In the presence of an acid it is, of course, true that both the hydrogen peroxide and the manganese dioxide break down losing one-half of their oxygen.

The metals act catalytically especially when in a finely divided condition. Indeed, the catalytic action of any metal is greater the more finely divided its condition. Take metallic platinum; a sheet of it may act catalytically, but platinum sponge or platinum black will have much greater power to accelerate the velocity of the reaction in question, and this brings us to some recent work on the catalytic action of very finely divided metals.

When we were discussing the methods of preparing colloidal suspensions, it was pointed out that colloidal suspensions of the metals can be readily obtained by bringing two pieces of the metal in question near together under water and passing an electric current between the metals. Under these conditions the metal is torn off in a very finely divided state, and remains suspended in the water as a colloidal suspension.

Finely Divided Metals Act Like Ferments

These finely divided metals have a powerful catalytic action. They resemble in their catalytic action the organic ferments, which are important catalyzers in the living body. The catalytic action of these finely divided metals can be inhibited by very small quantities of the same substances that "poison" the organic ferments; but we cannot go further into this. The important point to remember here is that the catalytic action of a metal increases with the surface of the metal. Keeping the mass of the metal constant and simply increasing its surface increases enormously its action as a catalyzer. The best way to increase the surface of a given mass of metal is, of course, to divide it more finely. This fact is important as we shall see when we come to discuss the meaning of catalysis.

Catalysis in the industries is coming to play a more and more important part. The manufacture of sulphuric acid by the action of oxygen on sulphur dioxide depends upon the presence of a catalyzer. At one time highly heated platinum was employed, but it was found that highly heated metal oxides act satisfactorily. Just one other application of catalysis to a technical problem will be considered.

Catalytic Fixation of Nitrogen

One of the most important industrial problems at present is the so called "fixation" of nitrogen; the conversion of free nitrogen into ammonia and nitrates. Haber has recently worked out a catalytic process of making ammonia. When nitrogen and hydrogen are brought together under pressure, and heated in the presence of hot metallic uranium, the metal acts as a catalyzer and causes the nitrogen and hydrogen to combine directly and form ammonia gas.

In addition to the true catalyzers we have the substances which accelerate the velocities of chemical reactions by taking part in them. The substance may form an addition product by adding itself to one of the substances that take part in the reaction, and then this added substance split off again in the free condition.

Such substances are known as pseudocatalyzers to distinguish them from true catalyzers. The study of pseudocatalyzers is much less interesting than that of the true catalysers.

The important question still remains. How do catalyzers act if they do not take part or enter directly into the reactions whose velocities they accelerate? A number of answers have been given to this question from the time of its discovery by Berzelius down to the present. The most important point in connection with electrolysis, is the connection between the amount of surface exposed and the catalyzing action. This raises the question what has surface to do with catalysis? How does the surface of a metal differ from the interior?

The difference is to be sought in the large amount of energy that is piled up at the surface of things. In the case of liquids we have seen that it manifests itself in surface tension. While we cannot measure the energy at the surface of solids, we have every reason to believe that it is there in large quantity. The introduction of this large amount of energy renders the system more unstable and chemical reaction is, in consequence, accelerated. Just how this surface energy renders the system more unstable we at present do not know; and in so far our knowledge of the innermost nature of catalysis is at present unsatisfactory. What we really know is that there is some close connection between the surface energy of the catalyzer and its catalytic action.

How to Change Reaction Equilibrium

This is a matter of fundamental importance for the engineer. Given a chemical reaction which produces a certain amount of a certain product that is desired. When equilibrium in the reaction is reached it means that the maximum amount of the substance in

question is formed which, under the conditions, can be formed. If the substance in question is the thing desired, it is obviously most important to find some method of changing the natural condition of equilibrium, and shove it further along as we say, that is, in the direction which will yield more of the desired substance. Indeed, the importance of being able to do this, from the standpoint of the industries, cannot easily be overestimated.

Much has already been accomplished in this direction. When we were discussing the development of the law of mass action, we saw how the amount of ester formed in the reaction between the alcohol and acid could readily be increased. It was only necessary to increase the mass of one of the substances present relative to the other. Indeed, it was the quantitative study of this reaction that furnished some of the best data that led to the exact formulation of the effect of mass in chemistry, or, as we say, to the discovery of the law of mass action.

Different Solvents Change Equilibrium Point

There are other methods of changing the equilibrium point than to change the relative masses of the reacting substances. The medium or solvent in which the reaction in question takes place often has a marked effect on the equilibrium point. This would be expected to be the case. We have seen that the different solvents have different dissociating powers, and since chemical reactions are due primarily to ions, the actual numbers of the ions present would affect not only the velocities of the reactions, but their equilibria as well.

Further, different solvents have different viscosities—and this affects the speed with which the ions move through the liquid; and the frequency with which they come in contact with one another.

One other effect has already been referred to in another connection, but should be mentioned here for clearness and completeness. That is the effect of temperature.

Effect of Pressure and Temperature

The effect of rise in temperature is to shove the equilibrium in the direction which involves the absorption of heat. Rise in temperature therefore opposes exothermic reactions, and favors endothermic reactions.

A reaction may, however, be exothermic at one temperature and endothermic at another. Thus, hydriodic acid is formed as the result of an endothermic reaction at ordinary temperatures, and consequently, rise in temperature favors the formation of the acid from its elements. This is, however, true only up to about 320°. Above this temperature the acid is formed from its elements as the result of an exothermic reaction. Consequently, further rise in temperature diminishes the amount of the acid formed.

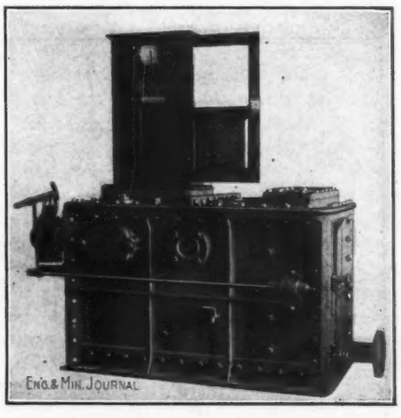
Similarly, ozone is stable below 200° and above 1000°, since the thermal character of the reaction involved in its formation changes with the temperature.

It has already been pointed out that the effect of pressure is to shove the equilibrium in the direction of smallest volume.

The generalizing of the effect of temperature and pressure on chemical equilibrium we owe to the distinguished French chemist, Le Chatelier.

Lea Water Flow Recorder

In these days of scientific management, when so much depends on getting at the root of the evil in order to correct abuses, the Lea water-flow recorder is an aid in keeping an accurate record of



Lea Water-flow Recorder

happenings in the boiler room. It shows all irregularities in the boiler feed, records the quality of water evaporated per pound of coal, and thus shows the number of heat units in the coal.

The apparatus works on the V-notch weir principle and is described as follows: A float spindle passes through the bottom of the instrument case, gearing into a small pinion upon the axis of a drum revolving between centers. Upon the body of the drum is a screw thread, the contour of which is the curve of flow for the V-notch, in connection with which the recorder is used. The spiral drum serves a double purpose: Its screw thread rectifies the motion of the recording pen, so that it moves equal distances for equal increments in the rate of flow; it provides a magnified scale for making an accurate observation of the rate of flow at any moment.

The actual depth of water in the notch can always be observed, and the instantaneous rate of flow in pounds or gallons can be seen with a high degree of accuracy. The recording pen which moves in direct proportion to the rate of flow produces a diagram, the area of which is a measure of the total quantity, and this can easily be deduced by means of a standard planimeter.

Heretofore, the Lea recorder was made on the open or atmospheric principle, but recently the manufacturers added a new type. The notched tank is made of cast iron, similar to the standard open-heater construction. The tank is entirely closed and is suitable for withstanding any pressure or vacuum up to 10 lb. The operating head of the Lea recorder is only about 18 in. Hence it can be installed without extensive changes in piping. It is made in sizes from 200 to 10,000 boiler-horsepower.

Besides being used for the measurement of boiler-feed water, steam consumption, etc., the Lea recorder can also be used for measuring pump discharges, flow of streams, acids, etc. For measuring the flow of acids the apparatus is provided with wooden tanks lined with lead, and the V-notch plate is similarly made. Hard lead or glass, however, can be used.

The apparatus is guaranteed to produce records which shall be within 1½% of absolute accuracy by weight; also that the average error due to variations of temperature over a range of 50° F. (i.e., 25° F. on either side of the normal shall not exceed 0.5%. A feature claimed for the Lea recorder is that it is equally accurate at large or small rates of flow. Moreover, accuracy can be checked at any moment by observing the head flowing over the V-notch and computing the flow by Thompson's formula, and then seeing whether the record on the chart is being made accurately. The apparatus is made by Yarnall-Waring Co., 1109 Locust St., Philadelphia.

Copper-Nickel Additions to Iron

C. F. Burgess of the chemical-engineering department of the University of Wisconsin, at Madison, Wis., under a grant from the Carnegie Institution, of Washington, has been making experiments for the use of copper-nickel additions to iron with a result of indicating that the use of this combined alloy may develop into a valuable improvement in the field of alloy steel.

The experiments have indicated that the long standing and well developed prejudice against the existence of copper in iron or steel is not entirely well founded. The results of these experiments open up a new avenue for the utilization of the natural alloy of copper and nickel, Monel metal, which results at one stage of the treatment of the Sudbury (Ontario) ores.

The Eastern Michipicoten Iron Range

By Alois Goetz*

This range north of Sault Ste. Marie, in Ontario, includes the Helen, Mildred, Lucy, Ruth and Josephine properties. The outcroppings show a cherty, siderític iron formation in a green schist area, carrying about 35% iron. Drilling has disclosed some red hematite carrying 59% iron and of bessemer quality.

*Chandler Heights, Sault Ste. Marie, Michigan.

The following notes are derived principally from memoranda taken while staking and prospecting the five different properties on the eastern Michipicoten iron range in Canada. The first discovery was made Aug. 25, 1897, and the claims then staked were sold in 1899 and are now owned and mined by the Lake Superior Corporation, of Sault Ste. Marie, Ontario, which named them the Helen mine.

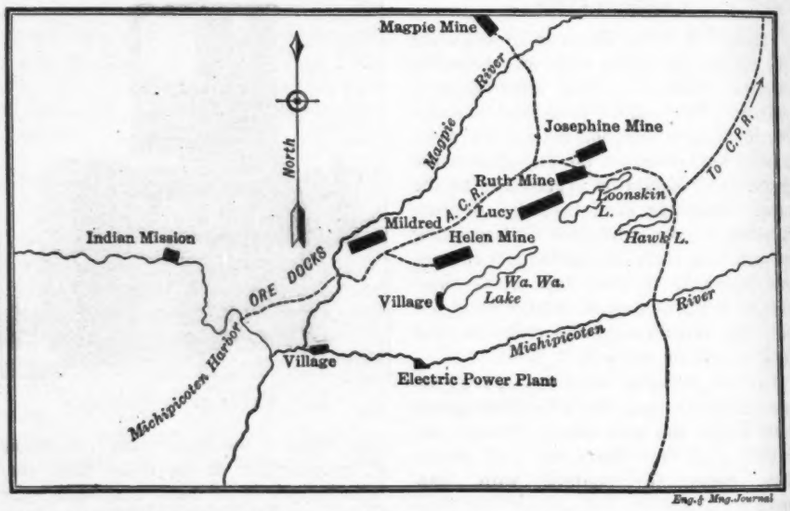
The Helen Iron Mine

The important part of the range commences near Sayers Lake, a small deep basin of water lying entirely in the iron formation, and is less than one-fourth mile long. On the south shore of Sayers Lake are large outcrops of pyritic, silicious rock which often becomes nearly pure pyrites. The iron rocks are bounded on the south by quartz porphyry and green schists, and on the north by green schists, all striking northeast, with a steep southerly dip. On the northwest shore of Sayers Lake, the iron rocks are brecciated and also show much pyrites in the granular rock. Along the north shore high, steep hills of banded chert, much broken, stretch to the easterly limit of Boyer Lake, which is also a small, deep body of water with a length of about one-fourth mile, lying less than 300 ft. east of Sayers Lake. The southern shore of Boyer Lake consists of quartz porphyry and green schists, but the usual iron rocks are in the bottom of the basin. The rock between the two lakes is mostly pyritic, and a small lens of siderite is found on the southwest end of Boyer Lake. The iron formation along the two lakes has a width of over 800 ft. On the northeast shore of Boyer Lake, a diabase dike, about 20 ft. wide, cuts through the iron formation in a southerly direction. Its course down hill to the shores of the lake can be seen plainly, as the dike rock, and the iron rocks at this point show no change by the contact. There can, however, be no doubt about this dike having greatly shattered the iron rocks in its course southward, fracturing them most severely along the south part of the range and thereby aiding their destruction by weathering and so forming a deep valley bounded on the south by the schists.

Orebody Crops on Surface

In this carved-out valley, the iron orebody was found cropping on the surface. The ore formed the point jutting into Boyer Lake at its southeast end, and extended as a low ridge, eastward for over 600 ft., having a width of about 400 ft. covered with a mantle of moss and sometimes earth. Just north of the iron and close to the point, an almost vertical cliff, facing the lake, rises. This cliff consists of alternate bands of iron and quartz, quickly rising into a hill 450 ft. high, which, in its easterly course, circles around the valley wherein the ore lies, joining on the south the high schists having an easterly strike, and together they then run as a high, narrow ridge for about three-fourths mile farther northeast, sinking then into a broken country of schist rocks. The hillside, pitching steeply southward into the valley toward the orebody, shows a smooth, brecciated iron rock and the side, sloping more gently, but still steeply, westerly into the same valley, is covered by large masses of broken rock, some of which is siderite. Several trenches have been dug on the top of the western end of the hill, disclosing the drift-covered range. Taking a section across the ridge on the eastern trench, from north to south are found: Rusty granular chert and banded chert, 450 ft.; siderite, 28 ft.; undetermined rock, 55 ft.; siderite, 28 ft.; undetermined rock, 37 ft.; siderite, 20 ft.; schist, 5 ft.; siderite, 60 ft.; in all, 136 ft. of siderite. After this comes the green schist. From this point the iron rocks gradually narrow, and where they end, the rusty, granular silica and banded chert are about 200 ft. wide and the siderite less than 50 ft. From geological conditions it was thought quite possible that ore might occur under Boyer and Sayers Lake, under the hills north of the two lakes, and under the high hill east of Boyer Lake. Since acquiring the property, the Lake Superior Corporation has constructed ore and other docks at Michipicoten Harbor, built the Algoma Central Ry. to the Helen mine, a distance of about 12 miles, and is now engaged in completing the railway to other mines in the district, as well as to Sault Ste. Marie, Ontario. The orebody was found to be much longer than shown on the surface, and has great depth; large quantities have already been mined and shipped. Boyer Lake has been pumped dry, and exploration under it has resulted in finding a large high-grade hematite orebody.

In the small area so far explored, bodies of pure pyrites have also been found in both granular and massive form, with bright prospects of finding much more in the large untested area. Siderite is said to have been found at a depth of over 500 ft., south of the hematite ore in the valley, and when it is remembered that the hill top, whereon the siderite crops, is over 400 ft. above this valley, it appears that the siderite might have a depth of 1000 ft. There are large quantities of this class of ore which carries about 35% iron, and when the possibilities of finding red hematite under Sayers Lake, and the other two places mentioned, are taken into consideration, the future of the Helen mine is bright.



Mines on Michipicoten Range at Eastern End of Lake Superior, in Ontario

The Josephine Iron Property

The Josephine property extends along the main part of this belt for 1⅛ miles in a northeasterly direction, and is owned

by Sault Ste. Marie, Mich., men. It is situated 10 miles northeast of the Helen mine on a spur near the main line of the Algoma Central Ry.; the distance to the harbor at Michipicoten is 20 miles. The iron formation is similar to the Helen, consisting of banded, rusty granular, pyritic and oxidized sideritic chert, and lenses of siderite, the general width being over 600 ft. The enclosing rocks are green schist and slates on the north, quartz porphyry, green schists and in some places limestone on the south, all dipping steeply to the north. A portion of the western part, or about one-fourth of the property, is covered by the waters of Red Lake, which is within the iron formation. Several islands in the lake consist of iron rock. From this it was inferred that there was iron ore beneath the bottom of the lake, and diamond drilling has revealed red hematite, containing 59% iron and of bessemer quality. E. F. Bradt, who was in charge of the drilling, stated that the orebody has been shown by diamond-drilling to be over 3000 ft. long and at a depth of 500 or 600 ft. to have a width of 50 ft.[1] The depth of this orebody is unknown, but is believed to be great.

Besides the red hematite, some drill holes near the southeast end of Red Lake show several close-lying, parallel lenses of siderite, having a total width of over 75 ft., but of undetermined length or depth though one hole cut the siderite at an angle of 45° at a depth of about 300 ft. below the shallow waters of the lake. Outcrops of siderite are seen along the south of the iron formation on top of the high hill east of Red Lake, and at the eastern boundary an outcrop 50 ft. wide is seen; while no stripping has been done, this is apparently an extension of the outcrop seen on the same hill to the west. If so, the lens would have a length of over 2000 ft. Considering the height of the hill and the depth shown in the lake, it would indicate a depth of at least 600 ft. This, and the lenses cut by the diamond drill, are large enough to warrant the expectation of the existence of large quantities of this ore which contains about 35% iron. The iron rocks on the hill east of Red Lake are greatly shattered and broken; no drilling has been done here but the prospects from a geological standpoint are favorable for the existence of red hematite under this hill. Large bodies of pure pyrites have been found at the Helen, and as the conditions at the Josephine are similar, they may be expected to occur here also.

The Ruth Mine

The Ruth property, also owned by Sault Ste. Marie men, is less than one mile southwest of the Josephine and the Algoma Central Ry. runs southward through the eastern end of the property. The latter has a length along the important part of this belt of about three-fourths mile in a southwesterly direction. The iron formation is similar in character to the Helen and Josephine but the maximum width is much greater, being over 1000 ft. The greatly shattered iron rocks, though often vertical, dip generally steeply northward and are in a trough of green schists, with some quartz porphyry inclusions on the south of the lenses of siderite. Near the western boundary a high, steep hill rises rapidly, forming the iron range and the high hill running between Long and Leg Lakes. Long Lake is a narrow body of water extending along the north side of the iron rocks for about 3000 ft. Several small islands in the lake show ferruginous rocks, and the eastern part of the lake lies entirely in the iron formation. Leg Lake is a small, shallow lake lying to the south, near the eastern end of the property. On top of the high hill is a wet, boggy marsh, which at one time was probably the basin of a lake, carved out of the broken iron formation. The wide iron rocks are broken and open to the influence of meteoric waters, a condition looked upon as favorable for the development of red hematite orebodies. The Long Lake basin, under the hill and especially under the marsh basin, are ideal places for ore concentration. South of the iron rocks and a few hundred feet east of the west boundary, on top of the south side of the hill, an intrusive greenstone cuts off a portion of a lens of siderite and has changed it, by heat, into magnetite; east of this intrusive rock the siderite, which has here a width of 140 ft., has also been changed into magnetite for 100 ft. along its trend.

Dips Are Steep

The contact between the two rocks is sharp and is in a vertical plane. This lens of siderite has been stripped through the center for 1800 ft. east, and cross-trenched at short intervals, showing a solid continuous orebody, having a width in two places of 200 ft., though the general width is from 100 to 140 ft. About 1600 ft. from its western end it swings outward but still forms the top and also the side of a steep hill; about 150 ft. down the hill side, a short tunnel was driven northward into the side of the the siderite, showing the same steep or nearly vertical dip. Taking the length of the stripped area and the general width, and using the depth at which the tunnel was driven gives a large tonnage of ore carrying 35% iron, and when it is borne in mind that the dip of the ore in the tunnel is still steep, it is reasonable to expect the ore to go down deep with the almost vertical rock formation. From the eastern end of the stripping, the lens of siderite narrows rapidly to about 30 ft. and runs at that width 1400 ft. farther east where it ends in eruptive green schist, which here also has changed the ore into magnetite for about 80 ft. Between this siderite and the iron rocks there is a band of pyritic rock which often is almost solid pyrites. It has a length of about 1200 ft. and a width in one place of 100 ft., though the normal width is about 20 ft. Besides this band, there are other pyritic outcrops, so that the outlook for finding bodies of pure iron pyrites is favorable.

The Lucy Mine

The Lucy mine is about one-half mile south from the southwest end of the Ruth, and is owned by Kelly & Mayer of Sault Ste. Marie, Michigan, and associates. The iron range stretches as a high ridge for two miles southwest. From the western end it is less than four miles in a straight southwest course to the Helen mine, and about two miles west, over a level sand plain to Mile 14 on the Algoma Central Ry., which here runs northeast but which bends sharply to the south at the Josephine. The iron formation is similar to that at the Helen, and has a nearly vertical dip. Many trenches have been made across the range at short intervals, which gave a good opportunity for examination. At the eastern end the iron range, having a width of 150 ft., rises from under the surrounding green schists, and runs at this width for 600 ft. when it abruptly widens to over 800 ft. running at this width for about 1400 ft. when once more it narrows to 600 ft., keeping this width for about 2400 ft., at which point it is crossed by a narrow diabase dike. On the west of this dike the iron rocks are 500 ft. wide, rapidly narrowing to 400 ft. and near the western end to 300 ft., where it is cut out by the green schists which surround the iron range. The iron rocks here are also greatly broken and have permitted the free circulation of the iron-bearing solutions, which for ages have leached the crushed iron rocks, probably carrying the dissolved iron down into the underlying basins of impervious green schists. It has been noticed on the Michigan ranges that large ore deposits are apt to be found where the iron rocks have been most violently shattered and there is reason for believing that this may be true here also. Along the range on the south side of the iron rocks, there are five lenses of siderite, having various lengths and widths; the average dimensions of these are: 1600 ft. long and 120 ft. wide; 1650 ft. long and 53 ft. wide; 1050 ft. long and 27 ft. wide or a total length of 4700 ft. with a nearly vertical dip. This ore, which runs about 35% in iron, is here, as well as on the other properties mentioned, slightly pyritic, though there are large masses at the Ruth, and here also, which show no pyrites, are low in phosphorous and carry some lime and magnesia useful for flux-

[1]Twelfth Report, Bureau of Mines, Ontario, pp. 103 and 104.

ing purposes, and on roasting would probably yield a product running about 52% in iron. The roasting would eliminate the carbonic acid and the sulphur, and the ore would then also be practically without moisture and of good quality. The calcined ore ground fine in oil would also make a good paint of a deep brown color, requiring no dryer.

The Mildred Mine

The Mildred property is about one mile northwest of Helen Mine Junction. The iron formation consists of many varieties of chert and porous black slate. This range lies on top of a high hill and is about two miles long, ending in green schists on the east, and disappearing under a sand plain at the west. From the western end it is 1½ miles along the Magpie River sand flats to Mile 6½ on the Algoma Central Ry., or about eight miles to the harbor at Michipicoten. On the western end the range rises out of the sand plains into a high steep hill. The iron rocks wind south across 40 acres in the shape of a horseshoe and have a width of about 400 ft. The northern arm of the loop narrows rapidly to about 20 ft. and dies out. The southern arm widens to 650 ft. and runs east for 1100 ft., when the iron rocks open again, on the north, in a smaller horseshoe form. The southern arm here has a width of about 500 ft. and continues farther east for 1200 ft., ending in green schist. The northern arm has an average width of about 100 ft., and runs northeasterly for 1250 ft., where it sinks into a wet marsh. The rock inside of both folds, as well as on the outside of the whole range, is green schist, including however in some places, quartz porphyries on the south; the dip as a rule is about 70° south. The iron rocks are a crumpled and brecciated mass, having strikes and dips in most every direction. The northern iron rocks rise out of the marsh, forming the main range. They have a width of about 225 ft. and run 1500 ft. east, where they seem to be cut by a narrow greenstone. The iron rocks along this part are also greatly shattered and crushed and lie in a low basin on top of the high hill. East of the greenstones the iron rocks rise into a low ridge and widen to 350 ft., extending east for 2600 ft., where they are faulted. A swampy valley, bounded by higher green schists, follows along the broken iron rocks on the north, as well as on the south side, and both meet in the fault line.

Iron Formation Follows Lakes

A narrow, shallow lake, 1100 ft. long, extends along the range in the south valley at the western end, through which a portion of the iron rocks runs the entire length. Across the range from the eastern end of the lake, another narrow, shallow lake runs along the range in the north valley for 800 ft. in an easterly direction. In the fault-line valley there is a muddy pond and marsh, several acres in extent, into which the iron rocks dip on the west; on the east side of this marsh little iron formation is seen, but a considerable area of bog iron ore is seen here, and the iron range is shifted several hundred feet both north and east. The range rises into a still higher ridge, and the shattered iron rocks have a width of about 300 ft.; they run easterly for 2200 ft., shrinking then gradually and at the eastern boundary, 400 ft. farther on, to less than 25 ft. Where the range narrows, it runs along a wet marsh on the south; here considerable bog ore can also be seen. This, and the other area, have not been stripped or tested as to depth, on account of water, all the higher parts of the range having been trenched while doing the work necessary to obtain title. Less than one-half mile north and far below the iron range, the Magpie River flows in a narrow valley westward for about 2¼ miles, where the river bends sharply southward, making an elbow wherein the Mildred property is situated. The geological features of this entire belt hold out much promise for the existence of large ore-bodies in the various basins indicated along the range, which can, however, only be verified by diamond-drilling.

The Mocorito District in Sinaloa

By G. L. Sheldon*

The Mocorito mining district is in the northern part of the state of Sinaloa, Mexico, and extends from the Gulf of California eastward to the foothills of the coast range. It is a well-settled agricultural district. The principal town, Mocorito, is on the west bank of a small stream known as the Mocorito River, which runs dry for a part of the year. The town is about twelve miles east of the Southern Pacific of Mexico R. R., and about 65 miles northwest of Culiacan, the capital of the state. A wagon road, 14 miles long connects the town with Guamochil, the nearest railroad station.

Palmarito the Largest Mine

The principal mine is the Palmarito, six miles northwest of Mocorito. The vein is from 40 to 50 ft. wide, in andesite near limestone. The east side of the vein is exposed for a height of 100 ft. for a distance of several hundred feet along the strike. The ore, which assays about 15 oz. silver per ton, can therefore be cheaply quarried. It was formerly crushed in a five-stamp mill and treated profitably by lixiviation. Five years ago the property was purchased by Philadelphia men who built a 100-ton lixiviation plant. This treatment was not a success so the cyanide process was adopted and under the capable management of A. W. Morris, who installed modified Pachuca tanks, Dorr classifiers and tube mills, 80 tons of ore are now treated daily, 75% of the silver being recovered. It is said that the capacity of the mill is to be doubled in the near future. The ore contains lead and its treatment by cyanide is attended by some difficulties. The Palmarito and Eldorado were the only mines in the state that were operated during the recent revolution.

The Eldorado mine is on a 3-ft. vein of free-milling gold ore which assays $5 to $6 per ton on the surface. The vein has been opened to a depth of 300 ft. and on that level the ore is still free milling. It is said that about 50,000 tons of $10 ore has been blocked out and that the building of a mill is under consideration.

There are many veins of a similar character in this vicinity. At the Belin property, 10 miles northeast of Eldorado several veins of gold-silver ore have been developed on a small scale. At Bequillas, 15 miles east of Mocorito a two-foot vein of ore, made up of copper and iron pyrites containing gold and silver, has been worked and the owner has shipped several lots of ore that returned him $100 per ton.

Numerous Promising Prospects

Several miles to the east of Eldorado near Sierra de Pajaros, is the Magistral vein which was worked 10 or 12 years ago. The ore contains copper and is rich in gold. There are several veins of copper ore in porphyry at Los Tajos, 35 miles east of Mocorito, which were extensively developed by Philadelphia men four or five years ago. A 25-ton wood-burning furnace was built, but fluxes were scarce so a concentrator was erected and several small shipments were made. The property has since remained idle.

The largest production from any one mine in the district is credited to La Jolla mine, 30 miles northeast of Mocorito. It was worked by Mexicans to a depth of not more than 300 ft. It is said that the dumps consist of silver ore of fair grade.

While the mineralized area of the district is small as compared with other districts in the state, there is a sufficient member of gold, silver and copper veins known to merit investigation and as there is a railroad in the district and operating costs are low, it is probable that it will receive more attention in the near future.

The extensive experiments which have been recently made to extract the vanadium from the vanadiferous coal deposits of Argentine and Peru have not been successful commercially.

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Vanadium—Its Ores and Uses

By Thomas F. V. Curran*

An account of the occurrences and applications of this important alloy metal. Discovered in 1803, its applications and metallurgy have only been developed within the last decade. The addition of small quantities of vanadium greatly enhances the useful qualities of various metals. The increased resistance of steel and cast iron to vibration and shock is especially noteworthy, and has stimulated the search for tractable vanadium ores.

*President, General Vanadium Co. of America, Continental Bldg., Baltimore, Md.

Vanadium is a member of the phosphorus group of elements and is of wide occurrence, though commercial deposits are comparatively rare; traces are frequent in titaniferous magnetites and in nearly all rocks, the smallest quantities being in persilicic rocks. In subsilicic rocks the amount is often as high as 0.05% of V_2O_5. It is also found in slates and other sedimentary rocks, also in French bauxite, in rutile, clays and oil-bearing shales, in coal and in the ashes of plants.

Del Rio, of Mexico, discovered the element in 1803, in the lead ores of Zimapan, but allowed himself to be persuaded by the fallacious assertions of French savants that it was impure chromium, hence the honor of the discovery was given to Sefstrom, of Sweden, who found it in 1830 in the Taberg ores.

Vanadium Ores

The principal ores containing vanadium are patronite, carnotite, roscoelite, vanadinite and the hydrocarbon asphaltite.

Patronite is a sulphide of vanadium, associated with pyrite, in a carbonaceous substance resembling slaty coal but abnormally rich in sulphur. It contains 35% vanadium sulphide, 5% iron sulphide, 35% free sulphur, 15% silica, and small quantities of molybdenum, nickel, alumina, lime, etc. It occurs at Minasragra, 30 miles west of Cerro de Pasco, Peru, in the Andes at altitude of nearly 16,000 ft. above sea level, in a lens-like vein having a dip of about 63°, thickness of from 3 to 6 ft. and length of 300 ft. The patronite ore is free-burning, is easily calcined and loses 45% of its weight in the process. The calcined ore contains about 52% vanadium oxide, (V_2O_5). The aluminous clays in the vicinity of the patronite vein are impregnated with solutions of oxidized vanadium. Possibly 5000 tons of these materials have been extracted.

Carnotite is a complex vanadium and uranium mineral of variable content, the usual commercial quality having about 4% vanadium oxide and 2% uranium oxide. It seems to be a canary-yellow ocherous pigment impregnating the siliceous sandstone and is to a large extent made up of calcium and barium compounds admixed with an amorphous silicate containing vanadium in the trivalent state, probably replacing aluminum. The stratas are flat, and vary in thickness from 1 to 4 ft. The color changes in proportion to the content of the vanadium or of the uranium. In ores containing 14% vanadium oxide and 3% uranium oxide (U_3O_8) with 3 to 4% sulphur and some carbonaceous matter, the color is a dark olive green, with yellowish specks, while in ores free from carbonaceous matter and high in calcium, the vanadium content is appreciably higher and the color is a brick-red, somewhat like soft iron oxide, but interspersed with minute particles of the yellow carnotite, or containing thin layers of the blended vanadium carnotite of duller yellow hue. The principal deposits operated are in the Paradox Valley, Montrose County, Colorado, and are over 50 miles in length and 12 miles in width. The occurrence is in the La Plata sandstone of the Jurassic age. Carnotite is found also in San Miguel, Mesa, Routt and Rio Blanco counties, Colorado; in Grand and Emery counties, Utah; in South Australia, Portugal and Turkestan. The shipments from Paradox Valley have totaled probably 2000 tons.

Roscoelite, which is a muscovite in which vanadium has partly replaced aluminum, or a closely related compound, occurs in blanket deposits in the Lower San Miguel mining district of San Miguel county, Colorado, as a replacement of the original calcareous cement. The deposits are persistent, thick and easily worked, and contain an average of about 3% vanadium oxide. The ore is milled close to the mines and the production so far has been probably 10,000 tons.

Vanadinite, $Pb_5V_3O_{12}$ Cl, occurs in a great variety of isomorphous mixtures, indicative of hydro-chemical reactions. Endlichite is a mixture of the arsenic and vanadium compounds; mottramite, a vanadate of copper and lead, is found at Alderley Edge, Eng., as an impregnation of the Keuper sandstone. A further variety is descloizite, close kin to ramirite found in many parts of Mexico. The vanadates occur principally in metalliferous veins, and their formation is attributed to percolating vanadiferous waters acting on other compounds, usually the compounds of lead. Several deposits occur near Cutter, New Mexico, associated with descloizite, lead molybdate, fluorspar, galena, barite and copper minerals. The average ore contains about 1% vanadium oxide and 5 to 7% lead. Considerable difficulty is experienced in mechanically concentrating the ore. Deposits also occur at Bayard, Hillsboro and Cook's Peak, while a somewhat higher grade vanadinite occurs near Tucson, Arizona.

Mexican Occurrences

In Mexico, vanadinite is found near Villa Rasales, Chihuahua, also at Coyame, Iturbide, and at Zimapan, Hidalgo; at Cardonal, in San Luis Potosi, at Charcas in the Sierra de Coronados, and at Catorce, as well as in Ojocaliente, near Berriozabal, Zacatecas. The vanadinite from Chihuahua is fairly pure and easily concentrated to 18% vanadium oxide. The ore from Zacatecas contains over 4% vanadium oxide and 64% lead but is frequently associated with arsenic.

Cuprodescloizite, or ramirite, is probably akin to chileite, which contains 13.5% vanadium oxide, 55% lead oxide, 14.6% copper oxide, and 4.6% arsenic oxide, 2% sand and clay, the remainder being lime, iron, alumina, etc. It occurs in Guanajuato at San Luis de la Paz, in San Luis Potosi, Matehuala, and Charcas. A variety that occurs near Zacatecas contains the vanadium in association with wulfenite.

In the descloizite as obtained from the River Plate district, Argentina, manganese replaces the copper and the vanadium oxide content is 22%, with 11% combined manganese oxides. Many varieties of vanadates occur in the silver-lead mines of Cordoba, some of the mines being extremely rich but flooded by underground streams.

The lead ores of Northern Spain contain from 4 to 5% vanadium oxide and by crude hand-dressing are concentrated to 12% vanadium oxide, with 35% lead, 13% ferrous oxide, 35% siliceous matter and about 3½ oz. silver to the ton.

Asphaltite Deposits

Asphaltite is an extremely soft, friable, lustrous substance, of very low specific gravity, containing about 80% hydrocarbon; it breaks into minute squares or cubes and burns with a long, smoky flame, yielding much tar. The vanadium content is quite uncertain, ashes from coal from the same deposit giving from 5% to 50% vanadium oxide. It occurs near Page, Okla., and at Palisade, Nev.,—a sample from the latter place giving

1.39% ash and 25% vanadium oxide in the ash.

There are many asphaltite deposits in Peru, those of the Yauli, being best known. The surface consists of three layers which at a slight distance unite and form a single layer from 7 to 9 m. thick, with average content of 1% vanadium oxide, which being burned to an ash yields from 25 to 40% vanadium oxide. Other mines are situated near Huanuco, a sample ton of ashes received recently giving 17% vanadium oxide. A lignite coal of this nature also occurs near San Rafael, Argentina.

In discussing the source of vanadium in certain ores, Doctor Hillebrand suggests:

> Coal is a possible source of the vanadium and perhaps uranium in carnotite and other evidently secondary minerals that contain one or the other of these elements. This suggestion is based on the repeated finding of vanadium in coal ashes and the observation of uranium in anthracite bitumen, in Sweden, and nodular forms of carbon from the oldest sedimentaries of that country, in grahamite from North America, and in carbonaceous materials from a pegmatite dike in Quebec. Further in the San Rafael swell, in the eastern part of Utah, vanadium has been found by me in relatively large amount in the carbonaceous material accompanying and impregnating sandstone, and at Cerro de Pasco, Peru, carbonaceous matter very rich in vanadium occurs. These facts are so indicative of a relation between vanadium and possibly uranium, and certain coals and carbonaceous materials that an examination of the coals and bitumens of western Colorado and eastern Utah for a possible content in these elements seems desirable. If found in them, the question of ultimate origin would still remain.

An ordinary steaming quality coal from Rockvale, Colo., gave 1.5% ash with 27% vanadium oxide in the ash. In operating the Jodandy carnotite mine in Paradox Valley, a small pocket was opened in the solid sandstone that was filled with pea-size pieces of red calcium vanadate, yellow siliceous carnotite, and vanadiferous coal. In the Minasragra deposit, the patronite is enveloped with veins of quisqueite and natural coke. The elevation of the Yauli deposits is about the same as those at Minasragra.

Kent Smith's Method for Vanadium

Comparatively few assayers in mining districts can accurately determine the vanadium content of ores. It therefore seems desirable to repeat J. Kent Smith's method which is as follows:

Weigh out 0.512 grams of the finely powdered material, and dissolve in HNO_3, if possible, or else digest in warm *aqua regia*. To the solution add an excess of strong H_2SO_4 and evaporate to copious fumes. The liquid is then diluted with water at about 30° C., permanganate added until the solution shows barely pink, and a measured excess of $N/10$ ferrous sulphate added. The excess of ferrous sulphate is titrated with $N/10$ bichromate, using ferricyanide on a spot plate, as indicator. The cubic centimeters of ferrous sulphate consumed in oxidizing the vanadium, as given by difference, represent the percentage of vanadium. Vanadium divided by 0.5614 equals V_2O_5 present.

In the case of ores and alloys difficultly soluble, a convenient way to bring the vanadium into solution is to fuse the ore or alloy in a nickel or iron crucible with about eight times its weight of sodium peroxide, dissolving the melt in water, boil, acidify with sulphuric acid, and proceed as usual. The clarity of the end reaction is much enhanced by having the solution well acid with sulphuric acid. Care should be taken that the ferricyanide indicator is freshly prepared, and that it is quite free from ferrocyanides; the crystals of ferricyanide should be rough washed before dissolving them.

To make a mere qualitative test to show the presence of vanadium, with ores difficulty soluble or containing much carbonaceous matter, reduce to an ash. (In non-carbonaceous ores, carnotites, vanadinites, etc., this is unnecessary.) Pour a teaspoonful of sulphuric acid into a test tube, then drop into the acid a small amount of ground ore or ash. Heat to fumes. Allow tube and contents to cool. Dilute with pure water; the coloration will probably be bluish green. Add a little peroxide of hydrogen, and if the color changes to dark red or mahogany, it indicates the presence of vanadium.

Growth of Vanadium Industry

The growth of vanadium industry will be appreciated when it is considered that the total value of the alloy produced in the year 1906 did not exceed $50,000, while the 1911 output was worth $1,500,000. The metal is silvery white and readily oxodized. It has a high fusing point but when alloyed properly with iron, the melting point is less than that of mild steel. Hence it is marketed in the form of ferrovanadium, an alloy containing two parts iron to one part vanadium. The present selling price of this alloy is $3.50 per lb. of metallic vanadium content.

Vanadium cleanses, toughens, and strengthens iron and steel to which it is added, rendering possible revolutionary changes in the lightening of parts, lengthening of service, increased safety, and the vitalizing of inventions otherwise impossible of practical operation.

In an address before the British Iron and Steel Institute 10 years ago, Prof. J. O. Arnold declared that vanadium was the master weapon of the steel metallurgist. The advanced steel makers accepted his dictum and encouraged their subordinates to renewed efforts in the commercial application of the element. However, stockholders were prone to consider profits rather than excellence of product. The public was not then ordering vanadium steel, although there was an ever increasing necessity for stronger and safer steel. The price of vanadium alloy was high, its quality irregular and its supply uncertain.

The industry needed a genius who should combine the attributes of the enthusiast with remarkable gifts as chemist, metallurgist and practical steel maker. J. Kent Smith, of Liverpool, England, has eminently filled this difficult rôle. In fact, the history of vanadium in the last decade is largely a story of his struggles, defeats and victories, in devising and making the various grades of vanadium alloy proved necessary in the production of the multitudinous types of vanadium steel and iron. He supervised personally the initial use of vanadium in most of the leading steel mills of the old and the new world.

Uses of Vanadium

Vanadium has accomplished wonders in crucible steel and in openhearth steel. It gives to cast iron greater strength and endurance, and copper and aluminum are remarkably improved for certain purposes by its addition. Engineers impressed by its valuable properties are gradually disregarding the first-cost fetish; wherever static or dynamic weakness, porosity, strain or vibration and shock, are to be overcome, vanadium is the infallible antidote. It is now being used in the steel for engine axles and frames, in transmission shafts and gears, in wire and springs, in piston rods, hydraulic cylinders, tires, tubes, boiler plates, bolts, gun shields, projectiles, armor plate, gun barrels, watch springs and in castings and forgings generally.

As vanadium unites with the nitrides and oxides and carries them into the slag, the quantity of vanadium that will remain in the steel is proportionate to the amount of scavenging to be done. In well deoxidized steel, the scavenging will consume about one-fifth of the vanadium. The method of adding ferrovanadium is very simple. In the crucible process, the alloy, broken small, is put into the molten charge with the second addition of the manganese. In acid-openhearth practice, the alloy, in large pieces, is dropped into the bath when the flame has been blanketed after the addition of the manganese and warmed silicon pig. In basic-openhearth practice, the alloy, broken small, is run through a spout that empties into the ladle in which the molten steel is being poured; a similar method is followed in bessemer and tropenas practice and also in the cupola process for cast iron, although in the

latter, the alloy should be crushed exceedingly small so as to melt readily.

Vanadium intensifies the effects of carbon, manganese, silicon, etc., hence materials of necessarily mild nature, such as boiler plates, chains, anchors, eye-bolts and products to be case-hardened, should contain only 0.12% to 0.14% vanadium in addition to the ordinary proportions of the other elements. For shafts, axles, castings, tires, saws, punches and dies, etc., the vanadium should be from 0.16% to 0.20%, while for springs a slight increase of the vanadium will be beneficial. For gun shields, protective deck and armor plates, etc., the vanadium should be from 0.30% to 0.40%. High-speed steel may be considered as an alloy; the usual practice here is to reduce the tungsten addition and to add from 0.35% to 0.50% vanadium, while in some of the Sheffield mills 2% of vanadium is added and the amount of tungsten is reduced one half or more. A few makers have substituted molybdenum for tungsten, with excellent results. In cast iron, vanadium addition varies in the different foundries using it, and ranges from 0.08% to 0.15%. Its effect is to scavenge, evenly distribute the carbon, eliminate porosity, refine the grain, check spalling and flaking, and lessen greatly the inherent brittleness. It follows naturally that these castings give unusual service records and that shop rejects are reduced so as to more than pay the cost of the vanadium.

Vanadium increases largely the resistance of metals to vibratory disintegration, and I predict that not only will all locomotives ultimately be made of vanadium steel, but all high-service materials will contain it.

Bosqui Zinc-dust Feeder

A recent invention of Daniel Bosqui (U. S. pat. 1,018,604), assigned by him to the Merrill Metallurgical Co., provides for automatically adding a proportionate supply of zinc dust to the charge of cyanide solution to be treated. The inventor claims that by the use of this apparatus there is a positive feed of a predetermined quantity of zinc dust to a given quantity of cyanide solution; a positive time contact for the zinc dust with the solution is provided before withdrawal to the filtering medium, and at the same time the solution is maintained in a continuous agitated condition during the entire operation of precipitation.

A side elevation of the apparatus is shown in the accompanying engraving. One of the receiving tanks is shown filled with liquid with its outlet valve open for the discharge of liquid, while the companion tank is being filled with liquid and has its outlet valve closed. The cyanide solution to be treated is alternately delivered to each receiving tank by means of a tilting launder *C*, which receives the solution to be treated from the feed pipe *D*. When the tank is nearly full, the solution acts against the float *E* which raises the inner end of the tilting lever *F*. This lever consists of a tubular rod or pipe partly filled with quicksilver and is supported centrally.

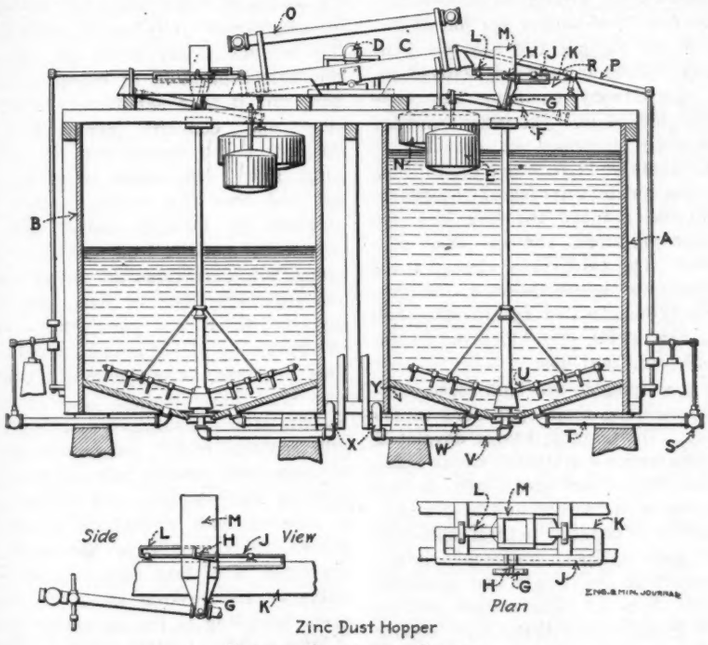
Attached to this lever and projecting upward is a forked arm *G*, the free ends of which, depending on the upward and downward movement of the float *E*, engage with a pin *H*, projecting laterally from a horizontally slidable arm *J*. This slide arm carries the cutter blades *K* and *L* which move within the zinc feed box *M* from opposite sides, working within milled grooves in this box. The cutter blades are spaced apart and the inner end of the blade *L* overlaps the inner end of the blade *K* for a slight distance, so that when the blade *L* makes a return stroke from within the zinc-dust box, the same moving in unison with the blade *K*, no zinc dust feeds out of the box. As the outer end of the lever *F* is depressed, the cutter *L* is moved into the feed box and the cutter *K* is withdrawn from it, allowing the zinc dust to drop from the feed box into the solution in the tank. The charge of zinc dust depends on the inside measurements of the feed box and the distance between the cutter blades.

• After the charge of zinc dust has been discharged within the tank *A*, the cyanide solution continuing to rise, actuates the float *N* which raises one end of the launder *C* and as it is carried above the horizontal position, the quicksilver in pipe *O* moves to the lower end. The resulting movement, being transmitted by a system of levers, opens the discharge valve *S*, permitting the treated solution to flow to the usual filtering medium.

The gold- and silver-bearing solution will now flow from the launder *C* into the tank *B*, the outlet valve of which is closed.

Tanks *A* and *B* are alike as to apparatus and operation. It will thus be seen that while one tank is being filled with cyanide solution to be treated, the treated cyanide solution contained in the companion tank is being withdrawn.

In each tank is an agitator *U*. In operation the liquid is drawn from the tank through the pipe *W* and is forced by the centrifugal pump *X* back into the agitator through the discharge pipe *V*. The pressure of the liquid thus forced into the agitators escapes through the nozzles *Y*, causing the agitator to be rotated at a suitable speed. The nipples are so arranged that the jets of solution striking the bottom of the tank tend to prevent any settlement of the precipitate. The only contact with air that possibly takes place is through the surface exposure of the solution which is a negligible quantity.



BOSQUI ZINC-DUST FEEDER

Zinc Trade of Germany

The exports and imports of zinc ores and products of Germany for the year 1911, are reported, in metric tons, as follows:

	Imports	Exports
Spelter	48,355	77,088
Sheets	467	36,093
Scrap	2,252	3,953
Zinc ore	262,398	48,998
Zinc dust	787	3,689
Zinc sulphide	2,719	13,740
Zinc white	4,977	20,677

Smelting in British Columbia

VICTORIA CORRESPONDENCE.

In the course of an address, by Robert R. Hedley, of Vancouver, B. C., presented at the annual meeting of the Canadian Mining Institute held in Toronto on Mar. 6-8, he gave the following information concerning the Consolidated Mining & Smelting Co., of Canada, Ltd:

OPERATIONS AT TRAIL

This company has established at Trail, B. C., a great metallurgical industry. Beginning with a small copper-matting plant, it now has complete modern copper-matting, and lead-smelting and refining plants. It is doing a large custom ore-smelting business, as well as smelting its own ores and operating, as owner, the following mines in British Columbia: Center Star, Iron Mask, Le Roi, War Eagle, and others, at Rossland; Phœnix Amalgamated and No. 7 group, in Boundary district; Molly Gibson, near Nelson; Richmond-Eureka, in Slocan district; and St. Eugene and Sullivan, in East Kootenay. Also, it is exploiting, under option of purchase, the Hudson Bay group and Silver Dollar, near Salmo; and the Tiger and No. 1. in Ainsworth camp.

The Consolidated company has always had an efficient staff in mining and metallurgy. Thus, its mines are operated to the best advantage; its St. Eugene concentrator, at Moyie, is lacking in nothing that conduces to successful working; and its smeltery at Trail is kept uptodate if not a little ahead. This company took hold of a crude and imperfect, but effective process for refining lead by electrolysis and perfected it in every detail. Although a little slow in putting in the Huntington-Heberlein process for roasting and desulphurizing ores, it improved on its accessories when it did install it, and it has been quick to recognize the advantages of the Dwight-Lloyd roasting and sintering machine, which it is striving to adapt to all its most complex conditions.

It is known that the company has for some time been at work on the problem of zinc metallurgy, but I do not know how near success it has got. This is with it a most vital matter, for in addition to the byproduct zinc concentrate of so many of the mills, it has in the Sullivan mine large bodies of ore the zinc content of which well nigh puts it out of the lead-smelting class; also an immeasurably larger quantity of ore quite excluded from that class by reason of its high zinc content. The company is now investigating the French process for reduction of mixed zinc-lead sulphides.

Concerning copper mining and smelting in British Columbia, Mr. Hedley, who was for a number of years manager of the Hall Mines smeltery at Nelson, B. C.

COPPER SMELTERIES

The large and modern plants of the Granby Consolidated Mining, Smelting, & Power Co., and the British Columbia Copper Co., both in Boundary district, have accomplished great things, both in mining and metallurgy. Each is so admirable in its achievement that it is sufficient to generalize on the chief features. Without handicaps of fuel shortage such as occurred last year, the total cost of mining and smelting ore and converting matte into blister copper may be safely stated as having been not more than $2.50 per ton of ore. Marketing the copper costs 20c. more. The ore generally averages about 25 lb. of copper, $1 in gold, and 10 to 20c. in silver per ton. Slag losses under present conditions rarely exceed 4 lb. of copper per ton of ore.

The B. C. Copper Co. has two blast furnaces 360x48 in. and one 240x48 in., while the Granby company has eight furnaces 266x44 in. The latter company has recently deepened its furnaces to give a column of 11 ft. above the tuyeres, which has not only increased the capacity, but has reduced the slag loss, the flue dust produced, and the coke consumption. The most recent change at the Granby works is in disposal of the slag, which will be elevated by traveling belt from a central pit, into which the granulated slag will first flow.

It is gratifying to see both these companies extending their operations in the province. The Granby, having developed to its satisfaction the Hidden Creek mine, at Goose Bay, Observatory inlet, is now proceeding with the erection of a smelting plant, with capacity to treat 2000 tons of ore daily. The management thinks it conservative to figure as available 6,000,000 tons of 2% copper ore, or if it be demonstrated that 1.65% copper ore will be profitable, to double that tonnage. The precious-metal content will probably be somewhat lower than at its Boundary District mines, but I can see no reason for expecting a higher cost at Hidden Creek than in the Boundary. True, coke will at the former be, for the present, either of inferior quality, or greater cost, but the sulphur content of the ore should permit the company to use but one-quarter the quantity.

The British Columbia Copper Co. has recently installed a cyanide plant at its Napoleon mine, situated not far south of the International Boundary line. It is now exploiting under option of purchase a large field of siliceous, low-grade copper ore near Princeton, Similkameen; also a big deposit of low-grade gold ore near Silverton, Slocan Lake. If proven worthy, the former will require the installation of a copper-reduction plant, and the latter a cyanide mill, at the respective properties. The establishment of a smeltery at Princeton would do much to encourage the opening of promising mineral claims in that district.

Experiments in Speiss Treatment

Some laboratory experiments were recently made by Barth on the treatment of a partly roasted speiss of the following composition: CoO, 25.79%; NiO, 18.78; Ag_2O, 0.30; PbO, 24.53; As, 5.66; Sb, 2.08; Fe_2O_3, 17.66; CuO, 0.24; CaO, 1.95%. According to *Metallurgie*, 1912, p. 199 (abstracted in *Journ, Soc. Chem. Ind.*, May, 1912), preliminary experiments showed that a convenient process consists in heating the material at 500 to 600° C. in a current of air containing sulphur dioxide, which converts the oxides of nickel and cobalt into soluble sulphates. It is not possible to do this in such a way as to get any considerable separation of nickel from cobalt, but it is a satisfactory first process and converts about 67% of the nickel and cobalt into the soluble form, along with traces of silver, copper and tin. The silver is then precipitated by metallic copper, and the copper by metallic iron. After precipitating the hydroxides of nickel, cobalt, and iron with milk of lime, and filtering, the nickel and cobalt are washed out by means of hot ammonium chloride thus producing a nickel-cobalt solution free from other metals. The insoluble residue after the sulphate roasting, which still contains nickel and cobalt in combination with arsenic and antimony, as well as lead sulphate and ferric oxide, is smelted with a suitable amount of galena. This quantity is calculated from the amounts of lead sulphate and ferric oxide in the residue so as to reduce them according to the equations: $6Fe_2O_3 + 2PbS = 12FeO + 2PbO + 2SO_2$; $2PbO + PbS = 3Pb + SO_2$; $PbSO_4 + PbS = 2Pb + 2SO_2$. This operation yields three products: (1) lead (containing silver), which may be treated in the ordinary way; (2) slag containing the bulk of the iron as silicate with a little lead, nickel and cobalt. This slag should contain 10 to 14% of silica and either the galena must be chosen so as to provide for this or else silica must be added. If it is melted with any sulphur-containing material the slag gives up its more valuable material as an infusible nickel-cobalt-lead sulphide which may be added to the original roasted speiss before the sulphating process; (3) nickel-cobalt speiss containing quantities of arsenic and antimony which are now so great as to be partly removable by roasting, the product then being sulphated by the air-sulphur-dioxide method as before.

The Mining Index

A Classified Bibliography of the Current Literature of Mining and Metallurgy

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19,028—GERMANY—Die Wasserwirtschaft von St. Andreasberg im Harz. Werner. (Preuss. Zeit. f. B., H. u. Salinenwesen, 1912, part 1; 18 p., illus.)

19,029—HAULAGE—Notes on the Margin of Safety Required by Government for Man Haulage at Great Depths. R. B. Greer. (Journ. South African Inst. of Eng., Apr., 1912; 1 p.)

19,030—HOIST CABLE BREAKAGE—Breaking of the Gold Cliff Hoist Cable. Lewis H. Eddy. (Eng. and Min. Journ., May 11, 1912; ¾ p., illus.) 20c.

19,031—HOISTING—Ming Hoisting Systems Compared—I. Bruno V. Nordberg. (Eng. and Min. Journ., May 18, 1912; 3½ pp.) 20c.

19,032—HOISTING—Ueber Schachtförderung aus grosser Teufe beim Steinkohlenbergbau im Oberbergamtsbezirk Dortmund. Schulze Höing. (Preuss. Zeit. f. B., H. u. Salinenwesen, 1912, part 1; 28 pp., illus.)

19,033—MANAGEMENT—The Science of Management in Practice—IV and V. Frederic A. Parkhurst. (Indus. Eng., Apr. and May, 1912; 19 pp., illus.) 80c.

19,034—MEXICAN LAW—The Conveyance of Mining Property in Mexico. D. A. Richardson. (Min. and Eng. Wld., May 4, 1912; 1½ pp.) 20c.

19,035—MINE REPORTS—Illogical Precision in Mine Reports. F. Percy Rolfe. (I. M. M., Bull. 92, May 9, 1912; 6 pp.)

19,036—MINING LAW—Birth of the American Mining Act—II and III. H. W. MacFarren. (Min. and Sci. Press, Apr. 20 and 27, 1912; 7¾ pp.) Conclusion of article previously indexed. 40c.

19,037—ORE TRANSPORTATION—all-Water Transport of German Iron Ore. Stuart Rice. (Min. and Eng. Wld., May 11, 1912; 1¾ pp., illus.) 20c.

19,038—ORE WHARF in Chile. Alfred Gradenwitz. (Eng. and Min. Journ., May 18, 1912; ¾ p., illus.) 20c.

19,039—PIPE—Wooden-Stave Water Pipe. Frank C. Perkins. (Mines and Minerals, May, 1912; 1 p., illus.) 20c.

19,040—PRUSSIA—Versuche und Verbesserungen beim Bergwerksbetriebe in Preussen während des Jahres 1911. (Preuss. Zeit. f. B., H. u. Salinenwesen, 1912, pt. 1; 66 pp., illus.)

19,041—PUMPING—Compressed Air Pumping Systems. Frank Richards. (Power, May 21, 1912; 2 pp., illus.) 20c.

19,042 — PUMPING — Raising Water by Compressed Air. Frank Richards. (Power, May 14; 1912; 1½ pp.) 20c.

19,043—PUMPING—The V-Notch Weir. E. H. Webster. (Eng. and Min. Journ., Apr. 27, 1912, 1½ pp., illus.) 20c.

19,044—SHAFT SINKING—Das Schachtabbohrverfahren von Stockfisch und seine Anwendung auf Schacht II der Gewerkschaft Diergardt. Krecke. (Glückauf, Apr. 6, 1912; 7½ pp., illus.)

19,045—SHAFT SINKING — Schwierigkeiten beim Schachtabteufen. Diancourt. (Bergbau, Apr. 25, 1912; 3 pp.) 20c.

ORE DRESSING—GENERAL

19,053—BLENDE-BARITE SEPARATION—Process for Separating Blende and Barite. F. C. Bryant. (Eng. and Min. Journ., May 11, 1912; 1 p., illus.)

19,054—CRUSHING—A Grizzly Crusher Feeder. S. A. Worcester. (Eng. and Min. Journ., May 4, 1912; 1 p., illus.) 20c.

19,055—EXPERIMENTAL ORE DRESSING AND METALLURGICAL PLANT of the Colorado School of Mines. Victor C. Alderson. (Met. and Chem. Eng., May, 1912; 3 pp., illus.) 40c.

19,056—FLOTATION of Minerals. Part II. Kenneth A. Mickle. (Proc. Royal Soc. of Victoria, Vol. XXIV, Part 2, Mar., 1912; 29 pp., illus.)

19,057—JIGGING—Joplin Jigging Practice. Claude T. Rice. (Eng. and Min. Journ., May 18, 1912; 1½ pp.) 20c.

19,058—SLIME CONCENTRATION—Concentration of Ore Slime by Centrifugal Separation. (Met. and Chem. Eng., Apr., 1912; 2½ pp., illus.) Describes apparatus patented by P. F. Peck. 40c.

METALLURGY—GENERAL

19,059—ALLOYS—Die Erhöhung der chemischen Widerstandsfähigkeit mechanisch noch gut bearbeitbarer, für Konstruktionszwecke Verwendbarer Legierungen. Otto Barth. (Metallurgie, Apr. 22, 1912; 15 pp., illus.) 40c.

19,060—BRONZES—Les Bronzes magnetiques. E. Masselon. (Metaux et Alliages, Feb., 1912; 1 p.)

19,061—CARBON—Das Schmelzen von Kohlenstoff. Borchers. (Metallurgie, Apr. 8, 1912; 1½ pp., illus.)

19,062—CHIMNEY—The Design of a Brick Chimney. J. Norman Jensen. (Eng. News, May 9, 1912; 3½ pp., illus.) Gives general principles to be applied in the design of an ordinary brick chimney and presents in detail the computations necessary for the design of a typical 125-ft. chimney.

19,063—FURNACE CHARGES—Calculation of Furnace Charges—IV. Regis Chauvenet. (Met. and Chem. Eng., Apr., 1912; 3½ pp.) 40c.

19,064—MONEL METAL. Richard H. Gaines. (Journ. Ind. and Eng. Chem., May, 1912; 4 pp.) Manufacture, composition, properties, uses, etc. 60c.

19,065—PYROMETRY—Radiation Pyrometry. G. A. Shook. (Met. and Chem. Eng., Apr., 1912; 3 pp., illus.) 40c.

19,066—SMELTER BUILDING in Chile. Frank Langford. (Min. and Sci. Press, Apr. 27, 1912; ¾ p., illus.) 20c.

19,067—SMELTER FUMES—Thiogen Process Demonstration at the Penn Smeltery, Campo Seco, Calif. L. H. Eddy. (Eng. and Min. Journ., May 4, 1912; 1¾ pp., illus.) 20c.

19,068—SMELTERY—The Pioneer Smeltery, Arizona. A. L. Waters. (Eng. and Min. Journ., May 4, 1912; 1 p., illus.) 20c.

MINING AND METALLURGICAL MACHINERY

19,069—AERIAL TRAMWAY—The Tesorero Mine Aerial Tramway, Spain. Frank C. Perkins. (Mines and Minerals, Apr., 1912; 1½ pp., illus.) 20c.

19,070—AIR COMPRESSOR—Abnahmeversuche an einem elektrisch angetriebenen Kolbenkompressor. (Glückauf, Apr. 20, 1912; 5½ pp., illus.) 40c.

19,071—AIR COMPRESSORS—Increasing the Efficiency of Air Compressors. S. R. Stone. (Min. and Eng. Wld., May 18, 1912; 3½ pp., illus.) 20c.

19,072—COMPRESSED AIR—Electric Heater for Air-Line Drains Used in Cobalt District. G. C. Bateman. (Eng. and Min. Journ., Apr. 27, 1912; ¾ p., illus.) 20c.

19,073—CRANES—Neuere Gieszbettkrane. F. Heym. (Stahl u. Eisen, May 2, 1912; 6½ pp., illus.) 40c.

19,074—DRILL BITS—Notes on the Design of Drill Bits. Ward Blackburn. (Eng. and Min. Journ., May 11, 1912; 1½ pp., illus.) 20c.

19,075—DRILL STEEL—Tempering Drill Steel. Clarence C. Semple. (Eng. and Min. Journ., May 11 and 18, 1912; 1½ pp.) 20c.

19,076—DRYING FURNACES — Mechanical Drying Furnaces. John S. Nicholl. (Mines and Minerals, Apr., 1912; 1½ pp., illus.) 20c.

19,077—ELECTRIC MOTOR—A New Type of Induction Motor. (The "Cascade" Single and Multi-speed Motor.) M. I. Williams-Ellis. (Journ. South African Inst. of Eng., Apr., 1912; 14 pp., illus.) 60c.

19,078—GAS-ENGINE POWER at French Mines and Smelters. Stuart Rice. (Min. and Eng. Wld., May 4, 1912; 2½ pp., illus.)

19,079—GAS ENGINES for Collieries. E. L. Chorlton. (Coal Age, May 4, 1912; 2½ pp., illus.) 20c.

19,080—GAS PRODUCER—The Peat Producer Gas Power Plant at the Government Fuel Testing Station, Ottawa, Ont. B. F. Haanel. (Journ. Can. Peat Soc., Nov., 1911; 6 pp., illus.) 40c.

19,081—HOISTING—An Interesting Overwind Preventer. (Coal Age, May 18, 1912; 1½ p., illus.) 20c.

19,082—HOISTS—Electrical Mine Hoists and Their Control—II. C. A. Tupper. (Min. and Eng. Wld., Apr. 6, 1912; 5½ pp., illus.) 20c.

19,083—HOISTS—The Control of Electric Mine Hoists. S. Haar. (Gen. Elec. Rev., May, 1912; 7 pp., illus.) 40c.

19,084—HYDROELECTRIC PLANT — Santa Rita Pressure Box. R. D. O. Johnson. (Eng. and Min. Journ., May 4, 1912; ¾ p., illus.) 20c.

19,085—LOCOMOTIVES—Vergleichende Untersuchungen an Grubenlokomotiven. Bütow and Dobbelstein. (Glückauf, Apr. 27, 1912; 5½ p.) Continuation of article previously indexed. 40c.

19,086—MINE CARS AND SKIPS—Die Eichung der Fördergefässe im Bergwerksbetriebe. Köbrich. (Glückauf, Apr. 27, 1912; 10 pp.) 40c.

19,087—POWER PLANT for Upper Michigan Mines. (Iron Age, May 2, 1912; 3½ pp., illus.) Describes high-head hydroelectric development on the Marquette Range for the Cleveland-Cliffs Iron Co. 20c.

19,088—SAFETY CONSIDERATIONS in Industrial Engineering. David S. Beyer. (Proc. Engrs. Soc. of W. Penn., Apr., 1912; 88½ pp. illus.) 60c.

SAMPLING AND ASSAYING

19,089—ALUMINUM AND IRON—Some Methods of Separating Aluminum from Iron. Gordon Surr. (Min. and Eng. Wld., Apr. 27, 1912; 1½ pp.) 20c.

19,090—ASSAY RESULTS—Presenting Assay Results by Graphic Methods. J. B. Stewart. (Min. and Sci. Press, May 11, 1912; 3½ pp.) 20c.

19,091—BITUMINOUS MATERIALS—An Examination of Some Bituminous Minerals. F. C. Garrett. (Journ. Soc. Chem. Ind., Apr. 15, 1912; 3 pp.)

19,092—CEMENT ANALYSIS—Ueber die Trennung des Calciums vom Magnesium. Kallauner und Preller. (Chem. Ztg., Apr. 23 and 25, 1912; 4½ pp.)

19,093—EVAPORATION—Ueber das Kaysersche Verdampfverfahren. Kayser. (Chem. Ztg., May 2, 1912; 1¾ pp.)

19,094—GAS ANALYSIS—New Forms of Apparatus for Gas Analysis. F. M. Williams. (Journ. Ind. and Eng. Chem., May, 1912; 1¾ pp., illus.) 60c.

19,095—QUALITATIVE ANALYSIS—A System of Qualitative Analysis for the Common Elements—Part V. Detection of the Acidic Constituents. Arthur A. Noyes. (Journ. Am. Chem. Soc., May, 1912; 32½ pp.) 60c.

INDUSTRIAL CHEMISTRY

19,096—ALUMINUM SULPHATE—L'etat actuel de l'Industrie des Aluns et du Sulfate d'Alumine. E. Cazes. (Journal du Four Electrique, Feb. 1, 1912; 2¼ pp.)

19,097—SULPHURIC ACID—The Theory of Sulphuric Acid Manufacture. W. C. Reynolds and W. H. Taylor. (Journ. Soc. of Chem. Ind., Apr. 30, 1912; 2 pp.)

19,098—WATER PURIFICATION—Beiträge zur Frage der Wasserreinigung. Schwarzer. (Chem. Zeit., Mar. 26, 1912; ¾ p.) Contributions to the problem of water purification. 40c.

MATERIALS OF CONSTRUCTION

19,099—CEMENT AND CONCRETE—A Study of Sand for Use in Cement Mortar and Concrete. E. S. Larned. (Journ. Assn. Eng. Soc., Apr., 1912; 18¼ pp., illus.) 40c.

19,100—CEMENT PLANT—Electric Driving in a Cement Factory. (AEG Journ., Jan., 1912; 5 pp., illus.) 20c.

19,101—CEMENT PLANT—Universal Portland Cement Company. Plant No. 6. (Cement Age, Dec., 1911; 3 pp., illus.) 20c.

19,102—CEMENT PLANTS—Dust in Portland Cement Plants. Otto Schott. (Eng. News, Jan. 13, 1912; 4 pp.) Paper before Am. Soc. of Mechan. Engrs., Dec., 1911. 20c.

19,103—CEMENT WORKS—Economic Construction of Storage Bins and Trestles at Cement Plants. W. S. Marston. (Journ. Western Soc. of Engrs., Oct., 1911; 15 pp., illus.) 40c.

19,104—DINA BRICKS—Ueber die Konstitution der Dinassteine. K. Endell. (Stahl u. Eisen, Mar. 7, 1912; 5 pp., illus.) On the constitution of dina bricks. 40c.

19,105—FIREBRICKS—Feuerfeste Kunststeine für Heizungen. (Bergbau, Jan. 18, 1912; 1 p.) Fire bricks for various purposes. 20c.

19,106—FIRECLAY INDUSTRY—Notes on the History and Development of the Fireclay and Refractories Industry. Francis T. Havard. (Wisconsin Engr., Jan., 1912; 8 pp., illus.)

19,107—PORTLAND CEMENT—The Adulteration of Portland Cement. R. C. Carpenter. (Eng. News, Jan. 18, 1912; 1½ pp.) 20c.

19,108—PORTLAND CEMENT and Cement Resources of the Southern States. T. Poole Maynard. (Proc. Am. Min. Congress, Oct. 24-28, 1911; 6 pp.)

19,109—PORTLAND CEMENT—Problems involved in the Selection of Machinery for the Manufacture of Portland Cement. Paul C. Van Zandt. (Eng. News, Dec. 14, 1911; 4½ pp., illus.) 20c.

19,110—PORTLAND CEMENT MORTAR—Some of the Properties of Oil-Mixed Portland Cement Mortar and Concrete. (Proc. A. S. C. E., Nov., 1911; 11 pp., illus.)

19,111—REFRACTORIES. Francis A. J. Fitzgerald. (Met. and Chem. Eng., Mar., 1912; 3¾ pp.) Results of research work on the manufacture and uses of alundum, crystolon, electrically calcined magnesia and fused lime. 40c.

19,113—TIMBER PRESERVATION—The Antiseptic Effect of Creosote Oil and Other Oils Used for Preserving Timber. John Morris Weiss. (Journ. Soc. Chem. Ind., Dec. 15, 1911; 5 pp.)

PERSONALS

Mining and metallurgical engineers are invited to keep The Engineering and Mining Journal informed of their movements and appointments.

Charles A. Chase has removed his office at Denver, Colo., to No. 734 First National Bank Building.

H. O. Swoboda, consulting mechanical and electrical engineer, has opened an office at Pittsburgh.

George W. Bissett, of Sudbury, Ont., has been visiting Tonopah, Goldfield and adjacent camps in Nevada.

A. S. Ross, manager of the Pittsburgh-Idaho Mining Co., at Gilmore, Idaho, has been in Pittsburgh, Penn., on business.

Calvin Haines, recently of Colorado, has been appointed manager of the Blue Mountain mines, near Sumpter, Oregon.

J. F. Musselman, of Los Angeles, Calif., is at Las Vegas, Nev., making some mine examinations in that district.

C. Stanley Martin, an English steel expert, has been appointed superintendent of the Dominion Steel Co. in place of C. H. McMillan, resigned.

George T. Robinson, superintendent of mines for the Cambria Steel Co., Johnstown, Penn., has resigned. He has been with the company 21 years.

The firm of Worthington & Pickard having been dissolved, Byron O. Pickard has established an office as consulting mining engineer, at Phœnix, Arizona.

J. H. Plummer, president of the Dominion Steel Corporation, has returned from an extended visit to England in connection with the finances of the company.

J. P. Tyrrell, Confederation Life Building, Toronto, Ont., has arranged with S. N. Graham to attend to his professional business during his absence this summer.

Guy J. Stock, Darlington, England, inventor of the Stock steel converter, is in this country, and is visiting a number of steel casting plants in the United States and Canada.

Prof. S. C. Ells, of Ottawa, will be employed by the Temiskaming & Northern Ontario Railway Commission to make a report on the harbor facilities of the mouth of the Moose River, on James Bay.

Simon Itura Patina, of Oruro, Bolivia, is visiting New York and intends to spend some time in the United States before extending his trip to Europe. He is the largest individual owner of tin-mining properties in Bolivia.

J. G. Kirchen, general manager of the Tonopah Extension Mining Co., was rescued from drowning in Martin's Creek, near Bethlehem, Penn., May 23, by Charles M. Schwab. They were on a fishing expedition together.

John Fritz, who is ill at his home in South Bethlehem, Penn., was remembered feelingly at the annual banquet of the American Iron & Steel Institute in New York, May 17. At Judge Gary's invitation the guests drank to Mr. Fritz's continued health and happiness, and a telegram was sent to him bearing good wishes and hopes for his recovery.

Arthur Cooper has been chosen president of the British Iron & Steel Association for the ensuing year. He is general manager of the Northeastern Steel Co. at Sheffield and is widely known in the steel trade. He has been a member of the association since 1874, and was awarded the Bessemer medal for his work in the development of the basic openhearth process.

OBITUARY

Henry W. Hoyt, recently of New York, but formerly of Baltimore, was drowned in the Orinoco River, in Venezuela, May 24, according to a despatch received from La Guayra. He was a graduate of Harvard University, 1897, a mining engineer, and had spent much time in South America. He went to Venezuela from New York recently, to examine some iron-ore properties on the Orinoco, in connection with John S. Williamson, of London.

Harry M. Hirst died at Tooele, Utah, May 16, aged 24 years. Born at Folcroft, Penn., Sept. 29, 1887, he was a graduate of Lafayette College, Easton, in 1908, and for the last 3½ years has been engineer for the Utah Metal Mining Co.; previous to that he put in some time in the coal mines near Pottsville. He died as a result of a cave in the tunnel of the Utah Company. His body was brought to his home and he was buried in Woodland Cemetry, Philadelphia. He was exceptionally fitted for his work as a mining engineer, and promise of a bright future was assured. Through his death the mining profession has lost one of its able young men.

Societies and Technical Schools

Massachusetts Institute of Technology—The Committee on Graduate Scholarships has recommended scholarships for R. D. Huxley, A. L. Matte, L. C. Tomlinson, E. L. Bray and H. E. Dexter, who are candidates for advanced degrees in electrical engineering, at the Massachusetts Institute of Technology. The popularity of the post-graduate study of electrical engineering at the institute continues to increase.

American Institute of Mining Engineers—The Spokane section held its quarterly meeting at Wallace, Ida., May 11. Papers were read by O. B. Hofstrand, of the Federal Mining & Smelting Co., on "The Macquisten Process of Ore Separation"; R. S. Handy, mill superintendent for the Bunker Hill & Sullivan Mining & Concentrating Co., on "The New Bunker Hill Mill." Visits were made to various mines and mills in and about Wallace.

Southeastern Missouri Lead Managers—Tuesday evening, May 22, Messrs. H. A. Buehler, state geologist of Missouri, E. S. Gatch, manager of the Granby company, S. B. Kirby, P. N. Moore, A. Thacher and H. A. Wheeler, gave a dinner at the St. Louis Club to the engineers of the Southeastern Missouri lead district. This, it is understood, is to be the first of a series of dinners, the purpose of which is to promote closer friendship and foster greater discussion of the problems of the district than has been characteristic of this important district in the past. The dinner was well attended. From the Federal Co. came H. A. Guess, the general manager, L. Johnson, the mine superintendent and Mr. Ring, the head engineer; from the Doe Run Co. O. N. Bilharz, the manager and Mr. Adami, the mine superintendent; from the St. Joseph Co., Roscoe Parsons, the manager, and Mr. Monio, the mine manager; and from the Desloge Consolidated, Furman Desloge, the manager; while owing to the detention of Mr. Comins, the manager, Mr. Carpenter, of the National Lead Co., represented its subsidiary, the St. Louis Smelting & Refining Co. The only smelterman at the first dinner was Mr. Porter, manager of the Alton works of the A. S. & R. Co. Prof. Overstrom, who has been installing his system of classification at the mill of the St. Louis Smelting & Refining Co., outlined the points in his system and made some remarks on the milling of these lead ores. He was followed by Mr. Guess, who gave a short description of the Federal plant, and then Mr. Bilharz outlined the history of milling in the district. Mr. Parsons reviewed the early history of the district from the beginning of the present period of mining activity, and the subject of the evening was changed to a more individual one when Mr. Gatch asked Mr. Moore, the new director of the Doe Run Co., and an old St. Louis resident, why, after Mr. Gatch had for years been heralding to St. Louis in particular the greatness of the neighboring lead district and the wonderful opportunity that there was there, he had waited until this year before he began to notice the district and began to acquire some portion in it. This Mr. Moore retorted to by inquiring what the astute manager of the Granby Co., with its thousands of surplus, had been doing that he, knowing the district so well, had not gobbled some of it long ago for his own company. After this pleasantry, the dinner ended in general conversation and discussion, with all feeling glad that the step toward bringing the engineers of the district together had been taken.

Editorial Correspondence

From our Representatiyes at Important Mining Centers

San Francisco

May 22—The installation of auto trucks at the Bunker Hill mine in Amador County and by the National Borax Co., will be watched by mining operators in California. The Bunker Hill has initiated the system in Amador County in the employment of one truck for the transportation of concentrates to the railroad at Martell, and the hauling of timbers and supplies to the mine. The distance is six miles, the road is a good wagon road and the grade is irregular but not difficult. When the road is dry there will be no difficulty, and it is possible that even in wet weather the road may not be too heavy for the motor. Should this undertaking prove economical there is a probability that other mines in Amador and adjoining counties in the Mother Lode region will adopt this method of transportation. The National Borax Co. has ordered five Saurer trucks for the transportation of borax across the desert to Bakersfield, from which point the product is shipped by rail to Galveston, thence by ocean vessels to Germany. The haul from the borax mines to Bakersfield is 40 miles over a desert road. It is planned to operate these trucks in 24-hr. shifts, and thus make practical demonstration of the ability of gasoline motors to stand this character of hauling. In many mining districts the crude oil used for fuel at the mines is hauled exclusively by motors, and in the oil districts much of the crude oil and most of the supplies are moved by this method. The employment of automobiles in passenger traffic is quite common in the mining districts, and there appears no good reason why the auto truck should not come into general use in most of the mining camps of the state.

The Palmer Union Oil Co. has completed its amalgamation with a newly incorporated British concern, the Palmer Union Oil Co. Ltd., and has secured $1,500,000 new capital with which to carry out development and improvement. New wells will be drilled and transportation facilities increased. The properties now operating are chiefly in Santa Maria and Ventura Counties, connected by the Associated pipelines and by rail with Port Harford. For the present these methods of transportation will be employed, as it is considered better economy to apply the funds to development of the oil measures than to the building of a pipeline, although there would be a saving of about 3c. per barrel.

Butte

May 22—The electrifying of the Butte, Anaconda & Pacific R.R., between Butte and Anaconda, has been under way for about a month. The first section to be electrified is the 3-mile branch from East Anaconda to the orebins at the Washoe smeltery. The main line, 26 miles long, between Butte and Anaconda, will be the next to be electrified, after which the lines to the various mines in Butte will receive attention, and finally the new branch from Anaconda to the Georgetown district, now under construction. The trolley system will be used, as the third-rail system would be dangerous, owing to the large amount of surface traffic over the line, which it is impossible to prevent. The electric motors will be similar to but more modern than those of the New York Central Lines. General Manager Harry Gallwey states that the company expects to have the entire system, including both freight and passenger service, in operation under electric power within a year.

Work on the construction of the branch of the Chicago, Milwaukee & Puget Sound R.R., from Three Forks into the Radersburg mining district, is well under way, and it is predicted that the mines will be shipping ore over the branch by Sept. 1. Track-laying will be commenced in about a week, three construction camps are established and five miles of grading have been done. The mining companies will effect a saving of $2 per ton by the new line, the amount now required to ship by wagon to the Northern Pacific R.R., at Toston; as a result, a number of properties are preparing to open, which have been closed for years.

Denver

May 23—The main orebody of the Vindicator mine has been opened at the 1500 level and the ore is said to be better than in the level above, which is further evidence of the permanence of good ore with depth in the deepest mines in the Cripple Creek district. Sublessees on the Hill City mine of the same estate are also producing high-grade ore. There are four other veins to be opened on the 1500 level, and it is asserted that the Vindicator will be a steady dividend payer for the next two years, even if no other oreshoot is opened. The Hill City shaft and workings are under lease to John Sharpe, of Cripple Creek, and there are 15 sets of sublessees who are shipping ore, the bulk of which is mill grade, but some of it runs from 3 to 5 oz. gold per ton. The Vindicator pays 3% quarterly dividends on its $1,500,000 capital stock and with the July dividend of $45,000, the shareholders will have received $2,587,500 on a gross production of $11,073,441, which is 23% of the value of the output, with a good cash balance in the treasury.

The dredges are at work again in the Breckenridge placers, in Summit County, and it is predicted that the Colorado, Reliance and French Gulch companies will take out gold worth $1,000,000 this season. The production of blende and silver-lead ores in the county this year will show an increase of from 20 to 35% over last year. The leading producer of these ores is the Wellington, near Breckenridge, and the next is the Wilson mine, near Robinson, owned by the King Solomon company. The mines of Montezuma and the Snake River district will help to increase the output.

Salt Lake City

May 23—The strike situation, at the Murray plant of the American Smelting & Refining Co., appears to be clearing. Three lead furnaces are in operation and about 275 men are at work. This is somewhat less than 50% of the regular working force. The demand on the part of unskilled laborers, chiefly Greeks and Austrians, for higher wages was refused, and early in the month the works were closed down. Strikebreakers were brought in, and on May 14 the first furnace was blown in; two more have since followed. Some of the strikers are returning to work. An attempt was made to dynamite some tanks at the plant, on May 16, but since then there has been little disorder, as active measures were taken by the county authorities to prevent disturbances. Armed deputy sheriffs are constantly on the ground. During the closedown, ore consigned to the Murray smeltery has been diverted to other plants. Some of this has gone to the United States smeltery, at Midvale, while other ore has been sent to the American Smelting & Refining Co.'s plant, at Pueblo.

According to a decision by the U. S. General Land Office, what are known as the Freed Coal Land Entries are held for cancellation, an earlier decision of the local land commissioners favorable to the defendants being reversed. The

case involves 4160 acres of coal land, in Huntington Cañon, Emery County, within the boundaries of the Manti national forest. The land is said to be worth about $1,000,000. Originally 26 entries were made, each on 160 acres of land, the entrymen paying the government from $10 to $20 per acre. Adjoining land has since been appraised by the government at $300 per acre. The average value of land in the neighborhood is about $100 per acre. During 1905 and 1906, some time after the entries were made, they were sold to C. M. Freed. The General Land Office holds that while there was considerable conflict in the testimony, the facts showing conspiracy were established, and that it was apparent the entrymen did not seek title for their own benefit. About a month remains in which to file protest to the Secretary of the Interior, who will make the final decision.

The remodeling of the Utah Copper Co.'s Arthur mill is nearing completion. The 10th section is in operation, and the 11th is ready. By July 1, all 13 sections are expected to be finished. When these are in operation, the capacity of the mill will have been increased from an original 3000 tons to 8000 tons or more per day. The capacity of the Magna mill was increased along the same lines from 8000 to 12,000 tons. It is expected that both plants will be operated at full capacity by July, and will handle approximately 20,000 tons.

Duluth

May 25—The Cuyuna district will have five and perhaps eight shipping mines this season. The Kennedy and Armour No. 1 and No. 2 are now shipping. The Meacham and the Thompson are about ready to ship. These are all on the north range. The Cuyuna-Mille Lacs and the Barrows, and perhaps the Adams, the latter two on the south range, probably will ship before the season closes. It is likely that the total season's shipments from the Cuyuna district may exceed 1,000,000 tons.

Calculations of total tonnage of ore of non-bessemer grade running better than 50% iron are variously placed at from 50,000,000 to 125,000,000 tons, depending on the strictness of construction of the term "developed ore," but it is certain that the district will be a large producer, perhaps as large as the Mesabi when its full extent is opened. The range practically extends for nearly 70 miles through Aitkin, Crow Wing and Morrison Counties. There are at least two distinct ranges for part of this distance and perhaps more, and each of these ranges presents several parallel but interrupted ore deposits. The ore on the south range is probably about 250 ft. below the surface and on the north range much deeper, probably averaging more than 400 ft. and in some places at least 800 ft. deep. The deposits are from 50 to 200 ft. wide.

Toronto

May 24—A gold rush has set in to the Whiskey Lake country, 40 miles north of Massey, on the Sault Ste. Marie branch of the Canadian Pacific Ry. The leading man in the movement is Jack Wilson, the discoverer of the Dome at Porcupine, and among other well known mining men who have gone are Clement Foster, A. W. ("Lucky") Scott, Benjamin Hollinger and Alexander Gillies. Wilson is said to have made the first discoveries, consisting of gold and copper, some time ago.

Cobalt

May 24—Work has been started in the old Cobalt Central mine, which is now known as the Penn-Canadian. The property has passed into the hands of a syndicate of Pennsylvania men who will develop it systematically. It has generally been believed that the mine had considerable merit but it was badly managed and finally forced to suspend operations. The old company was involved in litigation for years, but it is hoped that the property will now have a chance to demonstrate its merit.

Porcupine

May 24—At the annual meeting of the Jupiter Mining Co., held in Toronto recently, R. W. Brigstock, the consulting engineer, stated in his report that the results of development to date were satisfactory. The No. 1 series of veins has been opened on the 50-, 100- and 200-ft. levels, and at each level profitable ore has been found. The No. 2 series has been opened on the 100-, 200- and 300-ft. levels. On the 100-ft. level, 20 ft. of profitable ore was cut, but owing to the proximity of the lake, little work was done. There are indications of the extension of this orebody on the lower levels. No. 1 series indicates a width of 3 ft., assaying from $2 to $25. No. 2 series gives an average of $10 over greater widths. Over 3000 ft. of underground work have been accomplished for an expenditure of $100,000, which sum includes surface expenditures for buildings and equipment. The financial report showed cash on hand of $16,137 and liabilities of $8076. There remain in the treasury 320,529 shares of stock, which are under option at 40c. per share. This stock will be taken up as development expenses require.

The growing scarcity of timber suitable for fuel is forcing the mining companies, many of which have completely stripped their land of wood, to use coal. The McIntyre has ordered 2000 tons of coal, the first consignments of which are arriving, and several others will be obliged to do the same in order to continue operations.

Johannesburg

Apr. 22—The recommendations of the commission on miners' phthisis largely agree with those of the West Australian Government Commission on the same disease. A bill has been introduced into the South African Parliament which is causing perturbation among the mine owners and the miners whom it is designed to benefit. It provides that all persons taking up mining work must first be medically examined to ascertain their physical fitness and freedom from tuberculosis. No blasting certificate will in the future be issued without the production of such a health certificate. Compulsory examination of mine workers from time to time is provided for. The commission estimates that about 1000 cases of miners' phthisis will come up for compensation every year and the bill provides for the establishment of a fund for this purpose drawn from mine owners and men. Six pounds per month are to be contributed for every rockdriller at work; of this the mine owner contributes £4 10s. and £1 10s. will be deducted from the wages earned by the men, £3 being contributed for every other underground employee, the contribution being divided as before. The benefits in case of partial disablement will be £8 per month for one year and for total disablement £8 per month for life, but anyone accepting benefits is never to be allowed to resume underground work. Provision is also made for widows and children. It is expected that from £400,000 to £500,000 will be taken from the industry per annum if the bill becomes law. The bill in its present form has many defects and its consequences will be serious in several directions. Already the mines are quietly dismissing old employees suspected or known to be affected by the disease, and the miners now see that any such measure is an anti-white labor bill that must discourage the employment of whites underground. The bill means that 5d. per ton on present tonnage will be added to the costs, of which the mines must pay 75 per cent.

There is no doubt that men with tuberculosis should not be employed underground, as they infect a whole mine; but it is a pathological condition which may remain in the same state for a long period if the source be removed. Much is now being done to allay dust in the mines and to produce better ventilation; should the 32% of the workers who are affected be debarred from work, the conditions would be serious. No doubt the bill will be somewhat modified in its passage. Twenty-five thousand pounds has already under a former temporary measure been granted as compensation and in some cases where lump sums were awarded the miner simply spent it on holidays or dissipation and returned to work underground.

The Mining News

The Current History of Mining

Alaska

B. A. Earldey, general manager at Dolomi, has brought in lumber and other equipment for the mill to be erected there. The mill will contain 10 stamps and should be in operation soon.

Alaska-Treadwell—During April, the mills crushed 75,292 tons of ore, yielding $176,655 gross and net $69,887. Operating expenses were $79,818; construction, $26,949; development, 785 ft. The ore averaged $2.37 per ton.

Arizona

Gila County

Copper Reef—At this mine, 5 miles south of San Carlos, the erection of the new equipment is completed and the development of the mine has been resumed. The equipment consists of an Ingersoll-Rand, 5-drill compressor driven by a Stover low-grade-distillate engine and a pump for furnishing the mine and camp with water. The driving of the California tunnel, now in about 1000 ft., and the California drift, leading off from this tunnel, has been resumed, air drills being used. The tunnel is being driven to cut four veins having prominent outcrops and surface showings of copper and is expected to cut them at depths of from 1000 to 1200 feet.

Old Dominion—The concreting of the fourth section of the Kingdon shaft of the United Globe mine is progressing rapidly and will be finished in a few days, giving 710 ft. of finished concrete lining. It is believed that the remaining 300 ft. can be finished in one section.

Keely Cure—A strike of rich silver ore was reported recently from this mine, five miles north of Globe.

South Live Oak—The first hole passed through about 450 ft. of leached capping and on May 21 entered disseminated chalcocite ore at 455 ft. which became of commercial grade at 495 ft. This apparently continued to 520 ft. where the drill is said to have entered a probable fault in which it was still working on May 24 at 595 feet.

Mohave County

Gold Road—It is rumored that the company will increase its equipment by the addition of two tube mills, 20 stamps and other improvements. It is expected to increase capacity to 350 tons per day.

California

Amador County

Central Eureka—The cleanup in April is reported at about $12,000. The recent strike of good ore in the 2800-ft. level does not count in the April extraction and treatment. In February some barren ground was encountered, and development was directed to the 2800-ft. level.

Bunker Hill—More than 50% of the total production of bullion in April was recovered from the sulphurets, and the total yield of the mine was up to the average. An auto truck has been installed for hauling sulphurets to the railroad at Martell.

Plymouth Consolidated—The water has been lowered to the 1000-ft. level in the Pacific shaft. The lowest depth is 1650 feet.

Butte County

Nimshew Ridge—This mining and development company, operating three miles south of Nimshew, will resume work in June. Sluice boxes will be installed in the main tunnel, which is 897 ft. long, and the gravel washed as it is extracted.

Great Western Power Co.—This company will build a club house, gymnasium and cottages for employees, at Las Plumas station.

Calaveras County

Big Fraction—The 20-ton Huntington mill is in commission, working the dump. The mill is run by water power taken from the Mokelumne ditch. When the dump is cleaned, the mill will handle mine ore.

Melones—The machinery for the new electric hoist, to be installed on the 1350-ft. station, has been received.

Eldorado County

Golden Rule—This mining company has leased the Lukens property, at Cool. A drift will be run from the bottom of the 100-ft. shaft.

Humboldt County

Berch—This old placer claim is being operated this season by R. L. Young, of Orleans Bar. An exceptionally good water right enables operations to continue late into the summer.

California Mining & Dredging Syndicate—This company suspended hydraulic operations about a year ago, the flume having worn out. It is rumored that a dredge may be installed this summer. Fred T. Hale, of Orleans Bar, is interested.

Mariposa County

Mt. Gaines—It is reported that the mine is to be reopened as soon as A. R. Mains, of Los Angeles, who purchased it at a sheriff's sale, secures title in June. This mine is a former large producer, and is believed still to contain ore worth development.

Modoc County

Reports from New Pine Creek in the middle of May say the weather was mild, and that every train was carrying men into the camp. This good weather followed what was said to have been the worst storm known in the Highgrade district for several years. Besides the new townsite, one-half mile south of New Pine Creek, another is reported as being staked at Willow Ranch, six miles south.

Mono County

Standard—An electric pumping plant is contemplated for installation in the Lent shaft, to unwater the lower levels with a view of prospecting for new orebodies. Dividends amounting to $17,839 were paid in 1911, although at the beginning of that year the company feared it was facing a loss. J. R. Buchanan is superintendent.

Nevada County

Pennsylvania Consolidated—A second payment of $40,000 is said to have been made by A. H. Winn, of San Francisco, who holds a purchase bond. The purchase price is reported to be $500,000. The present operator has added 10 new stamps to the mill, an electric pump and has deepened the shaft.

Black Bear—A rich strike is reported. Free gold was found in an upraise in the tunnel about 150 ft. in from the portal.

Placer County

Three Queens—This mine, near Forest Hill, is to be reopened by Frank Savage. The mine produced $20,000 under bond to George Wingfield.

Herman—The fuel supply at this mine is being replenished and preparations for next year's fuel are being made. Ten new stamps are being added to the present 20-stamp mill. The gallows-frame at the station on the 600 level is being raised. The ore pockets at this station are being enlarged to facilitate the hand-

ling of ore due to increased mill capacity. New stopes are being opened and mill holes provided. The unwatering of the lower levels will be completed soon. The mine and mill will be in full operation early in June. This property is owned by the Pennsylvania Gold Mining Company.

PLUMAS COUNTY

Altona—A 12-hp. gasoline hoist is being installed for prospecting. The mine was a former producer of average-grade ore. The veins are from 18 in. to 7 ft. wide and have a dip of about 45 degrees.

SIERRA COUNTY

Butcher Ranch—This quartz property has been bonded to David Atkins and associates, of San Francisco.

Sierra City—The Keystone mine has resumed work, and the Cleveland and Bullion are about to resume after a suspension of several months.

Croesus—At this Alleghany mine work has commenced on the laying of 6200 ft. of 3-ft. redwood pipe to carry water from the Middle Yuba River to the power house.

Rainbow—The mill is being run three shifts on good ore, and the tunnel is being extended to develop the orebody recently cut. L. P. Woodbury is in charge.

Hayes Consolidated—This property has been transferred to a San Francisco company, and is in charge of Thomas C. Heide, a mining engineer of that city.

Flynn—In running for gravel on this property, good quartz has been encountered by Michael Flynn, the owner.

TRINITY COUNTY

Trinity Gold Mining & Reduction Co.—The 40-stamp mill and cyanide plant treated 6200 tons during April, of an average grade of $4.45. Net working profit was $7914. Five hundred inches of water under 400-ft. pressure are being used to remove overburden from the orebody.

Alta Bert Dredging Co.—The 7½-cu.ft. dredge installed by this company on the property between Carrville and Trinity Center on the Trinity River, has been working successfully since its completion three months ago. It is handling 3000 yd. per day with a daily output of $900. The company is contemplating the building of a much larger dredge. The land adjoins that owned by the Trinity Exploration Co.

YUBA COUNTY

Pennsylvania—A Beer roller mill and other necessary machinery have been received and are ready for installation. Concrete foundations are being built. J. C. Campbell, Browns Valley, is owner.

Tarr Mining Co.—The trial of the suit by the E. Clemons Horst Co., to enjoin the mining company from taking water from Bear River, has been postponed till September.

Colorado

BOULDER COUNTY

The Wolftongue mill at Nederland, and the Primos mill at Lakewood, have both resumed operations, after an idleness of several months. With the starting of these two mills the leasers throughout the tungsten district have a place to dispose of their ore.

Colorado Tungsten—This property, at Carrie Nation Park, has received its electric motors for the mill and they are being installed. The mill is expected to be ready early in the summer.

CLEAR CREEK COUNTY

The excitement last year in the Bard Creek district was stopped by the heavy snows, but the work carried on during the winter was encouraging, and many prospectors and mine operators are now going in again to this gold and silver section.

Capital—It is stated that this mine is the heaviest producer of gold in the county, and that during the last two months the production has been as high as $3000 per day from the plates, besides heavy shipments of concentrates and smelting ore.

LAKE COUNTY—LEADVILLE

Mt. Champion Mining Co.—The new machinery at the mill is being installed by Manager Smith, who expects to have the plant running by July 1. The ore is said to be 6 ft. thick, a horizontal vein carrying free-milling gold.

Roy—This group on Prospect Mountain was owned by the late Thomas F. Walsh, and it is rumored that his son-in-law, McLean, will develop the property this summer.

Leadville District Mill—This mill, in lower California Gulch, is being remodeled under S. H. Dunlop. When completed it will handle zinc-lead ores.

Resurrection No. 1—The lessees are shipping two cars per week of ore that nets $14 per ton.

Elk—The lessees have a body of iron ore 14 ft. wide, from which 20 tons per day are going to the smeltery. They are also shipping from a 4-ft. vein of lead ore.

Crescent—Men are cleaning out this tunnel of the Winthrop Mining Co., in Big English Gulch. It will be driven ahead into the mountain.

Gold Basin—The lessees have shipped to the local smeltery seven cars of ore that runs 1 oz. gold per ton.

OURAY COUNTY

Barstow—On this gold producer, near Ironton, in the Red Mountain district, 40 men are at work under C. R. Wilfley, manager. Shipments will commence as soon as the Red Mountain R.R. is in operation.

Atlas—Development is keeping 10 stamps busy, and the other 10 stamps will be put in operation. J. P. Sidwell, president, arrived at the mine from Boston this week, accompanied by Dr. Julius Garst, of Worcester, Mass., a large stockholder.

SAN JUAN COUNTY

It is stated that after being in operation for three months, the first plant erected in Colorado for the electrostatic separation of lead-zinc ores, at the Sunnyside, near Silverton, has been a success, as a 40% zinc product is made and the lead and copper recovered.

Congress—It is reported that a large body of copper ore, carrying gold and silver, has been struck by the lessees, Clay & Morris. There is a great deal of enargite in this mine.

Gold King—The mill at Gladstone has resumed operations and is dropping 40 to 60 stamps daily and turning out concentrates. The sublessees are encouraged by the pockets of gold ore being found, and they are doing extensive development. Sixty men are employed.

Vermillion—The mine was closed down last year, owing to shortage of funds. It is stated that the owners and officers are due to arrive soon in Silverton from Cleveland, Ohio, to straighten the affairs of the company and to resume operations.

SAN MIGUEL COUNTY

San Miguel Consolidated Mining Co.—The 110-ton stamp mill, in Bear Gulch, under lease to the Junta Gold Mining & Milling Co., was destroyed by fire on May 23. The company expected to have the mill in operation by June 15, as well as a tramway, which is under construction from the mine to the mill.

TELLER COUNTY—CRIPPLE CREEK

It is reported that Judge Colburn, president of the Ajax company, will build a Clancy mill at the Mary McKinney mine, work to commence within a month.

Golden Cycle—It is reported that about 280 tons of ore per day are being shipped to the company's mill, at Colorado City. A station is being cut at the 1700 level, and an electrically driven 1000-gal. station pump will be installed, which will lift the water to the second pumping station at the 1400.

Dante—The mill, which is being built by Edwin Gaylord, is progressing rapidly and the machinery will be installed soon.

Signal King Gold Mining & Milling Co.—William Christen, president, Cripple Creek, expects to install some machinery at this property. Some grading for a mill has been done, part of the water main is installed and lumber is on the ground.

Work—Extensive development, with occasional shipments, is being carried on by seven sets of lessees at the Morning Glory, Little Clara and Morning Glory No. 4, owned by this company.

Idaho

Stewart—Edward C. Carter, of Spokane, a stockholder and director, has brought suit against F. A. Heinze and others, for the appointment of a receiver for the company. It is claimed that the company has earned more than $950,000 in the last two years and that no dividends have been paid nor a proper accounting made.

Bear Top-Orofino—The company has gone into the hands of a receiver and the 20 claims will be sold. It is stated that the company is a producer of high-grade lead-silver bullion, that the equipment is complete and that 32 cars of ore have been shipped since October, 1911. Charles N. Mundell, 173 S. Adams St., Spokane, Wash., was former secretary.

Michigan

Copper

Indiana—Shaft-sinking is going forward satisfactorily, to develop the felsite formation revealed in drill cores. The shaft is sinking in trap, passing through the amygdaloid formation encountered at a depth of about 800 ft., which was highly mineralized for 20 ft. Developments on the lode exposed by the crosscut from the 600-ft. level continue encouraging.

South Lake—This company has selected the site for its shaft and will begin sinking soon.

North Lake—The Copper Range R.R. is running a spur to the shaft site, about a half-mile distant.

Copper Range—This company is installing a series of Hardinge conical tube mills in the Baltic stamp mill for fine grinding. A contract has been closed with the Allis-Chalmers Co. for a 1500-kw., low-pressure steam turbine to be installed in the Baltic mill also. This is the forerunner of a number of similar installations that will be made in the company's other mills and the latter will eventually be tied together with a common substation and the power used for the electrification of the mines.

Osceola Consolidated—The old Osceola branch is to be reopened soon. Repairs have been made to the shafts and alterations to the rockhouses, so that the property is in shape to handle economically an increased tonnage.

Isle Royale—The testimony in the injunction case of G. M. Hyams, restraining this company from purchasing a portion of the Lake Milling, Smelting & Refining Company and the Tamarack company from selling its two-head mill on Torch Lake to the L. M. S. & R. Co. was given at the general offices of the Calumet & Hecla company at Calumet during the last week, before Federal Judge Sessions. Vice-president Agassiz was called to the stand as was Mr. Hyams. The testimony was completed Friday morning and court was adjourned until June 3, when the final argument will be presented at Marquette.

Iron

Cleveland-Cliffs Iron Co.—This company is reported to have sold 2,000,000 tons of ore which will clean up the large stockpiles that have been accumulating for two years. The new North Lake mine is shipping ore; this property four miles west of Ishpeming has been developing for several years and now has a full equipment; two shafts, the Morris and Lloyd, are hoisting ore. The Negaunee mine, at Negaunee, the Lake and Cliff shafts at Ishpeming, and the Stephenson mine at Gwinn, are active.

Davidson—At this mine of the New York State Steel Co., at Iron River, the new engine house at the Gleason shaft is nearly completed. Wires have been strung from the steam plant of the Peninsula Power Co. and the new compressor will soon be running by electricity. This season the New York State Steel Co. will ship about 100,000 tons of ore from the mine, which last season made its initial shipment of 45,000 tons. The same company expects to ship 345,000 tons from its Mesaba range mines, distributed as follows: Kellog, at Biwabik, 160,000 tons; Roberts, at Biwabik, 20,000 tons; Knox, at Mesaba, 115,000; and 50,000 from the Larkin at Virginia.

Minnesota

Adams—Cuyler Adams is sinking a concrete shaft at this mine on the Cuyuna range, two miles southwest of Deerwood. The shaft is 12x15 ft. in the clear and will reach the formation at 125 ft. from the surface. It is now down 90 ft. and difficulty is being encountered in getting the concrete column to follow down as the sand is removed. Recently 500 tons of pig iron were used to weight it. The shaft and equipment for it will cost about $100,000.

Cuyuna-Mille Lacs—This company and the Iron Mountain company are each sinking shafts on the north range, about a mile north of Ironton.

Montana

Butte District

Butte-Alex Scott—During April, net earnings amounted to $25,000. Five thousand tons of ore were shipped to the East Butte smeltery, bringing gross returns of $39,700 and operating and mining costs were $14,700. Several small improvements are to be made at the mine, after which there will be a material increase in the output.

Tuolumne—The average daily shipments of first-class ore to the Washoe smeltery have been increased from 150 to 300 tons, and on May 15, a record shipment of 400 tons of ore was made, as a test of the new hoisting plant. The first-class ore averages about 7.5% copper, and about 5 oz. of silver. No second-class ore has been mined yet, but negotiations are under way with the Anaconda company for the treatment of this ore at the Washoe smeltery.

Butte & Superior—The first unit of the new mill has been completed and several test runs of ore made with satisfactory results. By June 1, the plant will be treating 400 tons of ore per day. Development in the mine during the last few months has increased the reserves. The vein on the 900-ft. level is 35 ft. wide of an average grade of 20% zinc; a raise on this level on the same vein is up 60 ft., the ore averaging 35% zinc and 30 oz. of silver per ton. On the 1200-ft. level, ore 25 ft. wide has been opened on the Four Johns claim. In drifting on the 1300- and 1400-ft. levels west of the shaft, the ore has maintained its width and grade.

Raven—Shaft sinking is in progress and the 1600-ft. level has been reached. A vein was encountered in sinking, which caused difficulty from a heavy flow of water. It is being taken care of by an additional sinking pump and work will progress faster. On the 1300-ft. level, a raise has been put up, and preparations made to begin stoping. An orebody on the 700-ft. level is being mined and occasional shipments made.

Broadwater County

Keating—The shaft is being sunk from the 700-ft. to the 800-ft. level, and when the railroad is completed, it is planned to increase shipments to about 200 tons of ore per day.

Jefferson County

State—Dr. O. B. Whitford, of Butte, owner of this group of claims, in the Bigfoot district, 15 miles from Boulder, has finally found a vein of high-grade gold and silver ore. He has operated the property intermittently for the last 25 years at an expense of $70,000. The vein has a width of 28 inches.

Bell—This mine in the Warm Springs district, 10 miles southeast of Helena, has been transferred to interests connected with the Corbin Copper Co. Work is to be commenced soon and a shaft will be sunk on the vein. The mine produced about $250,000, years ago. The ore is a heavy sulphide, carrying gold, silver, lead and copper.

Assets Gold Mining Co.—This company's property in Golconda Gulch, has been transferred to Colin McIntosh. Electric power has been carried into the property, which will be vigorously developed.

Lewis & Clark County

Some activity is being shown in the Marysville district; the St. Louis company is working the St. Louis and Nine Hour claims, and part of the Drumlummon, and several independent producers are oper-

ating. Other properties being worked in this vicinity are that of the Hendricks brothers, between Bald Butte and Marysville, and that of the Boyer brothers, on Deer Creek. The latter is installing new machinery.

Piegan—At this mine, situated between Marysville and Gloster, James Deering, owner, has men at work and is preparing to build a 10-stamp mill.

Bald Butte—George W. Padbury, manager, is preparing to start the mill at this mine; he has sufficient ore blocked out to last some time.

Powell County

Twin Cities—William O'Connel, president, recently visited the mine near Elliston. The shaft will be sunk to the 200-ft. level, and the vein developed. The equipment is on the ground and sinking will start as soon as the new headframe is completed.

Nevada

Comstock Lode

Mexican—The new clarifiers are being installed. This equipment is expected to increase the capacity to 100 tons per day, as well as to give a higher percentage of extraction. Last week, 583 tons of $22.64 ore were treated at the mill.

Ophir—The southwest prospecting drift on the 2500-ft. level continues to follow the east vein with the face in quartz across the width of the drift. The final shipment of concentrates from the run at the Kinkead mill has been made and included 31 tons of an estimated value of $25,200 and a bar of bullion worth $5100. The net proceeds from the run are estimated at $50,000, including a previous concentrate shipment.

Union Consolidated—A northeast drift has been started on the 2200-ft. level, from the south boundary line, and is being advanced in quartz. Work has been handicapped on the 2500-ft. level by air conditions, but a large blower has been ordered.

Consolidated Imperial—One station set of timbers was put in place last week at the new station on the 200-ft. level, and from the opening made for the timbers, 61 mining cars of ore were saved of an average grade of $33.32 per ton. This vein was cut in the sinking of the shaft, and after the station is completed will be thoroughly explored.

Esmeralda County

Blue Bull—Operations are reported to have been resumed. The Cosser & Terrel shaft, now 400 ft. deep, will be sunk to 700 ft., where drifting and crosscutting will probably be started. Developments at this mine will be watched with considerable interest.

Nye County

Shipments in tons from Tonopah mines to date and for the week ended May 16, are as follows:

Mines	Week	Year to Date
Tonopah Mining	3,300	65,519
Tonopah Belmont	1,750	41,426
Montana-Tonopah	1,017	20,262
Tonopah Extension	1,030	19,067
West End	775	14,184
Midway	.....	180
MacNamara	485	6,820
North Star	.....	80
Totals	8,357	167,538
Estimated value	$208,925	.....

The placer mines in Manhattan Gulch are employing about 100 men in channel mining and several new washing plants are being erected. Operations last winter were successful.

Nevada Reduction Co.—Charles J. Webb & Co., Philadelphia, have secured this plant. The cyanide department will be overhauled and the mill started.

Big Four Leasing Syndicate—The syndicate has sold its holdings to the Big Four Co., and the shaft is sinking to the 500-ft. level. The mine contains a quantity of low-grade ore above the 300-ft. level.

War Eagle—This 50-ton mill has resumed operation. Both this and the Philadelphia have contracted for enough ore to run continuously for three months.

Montana-Tonopah—The downward extension of the new vein recently cut on the 565-ft. level has been opened on the 665-ft. level and is 2½ ft. wide, assaying from $80 to $110 per ton. The company milled 4646 tons of ore in April.

White Pine County

Ely Verdi Copper Co.—This company, in which George Wingfield has been interested for some time, was recently reorganized. It is doubtful if active work is contemplated.

Boston Ely—Diamond drill work was started on May 9. The first hole will be put down from the bottom of the Emma shaft, starting at a depth of 1200 feet.

Taylor—It is understood that J. E. Spurr's examination resulted in the surrender of the option held by the Tonopah Mining Company.

Ely Central—This company is putting down a churn-drill hole on the Chispy claim, at a point less than 400 ft. south of the edge of the Copper Flat pit of the Nevada Consolidated. The hole was started east of the fault plane and went through it encountering low-grade copper sulphide ore at a depth of 300 feet.

Railroad Valley Saline Co.—The company is drilling its first hole in the old lake beds of Railroad Valley, and has reached a depth of nearly 600 ft. The formation so far consists of successive beds of sand and clay. The company holds 6000 acres of land. The existence of potash salts of commercial worth has not been shown yet. The point at which work is being carried on is 115 miles from Tonopah and 72 miles from Ely, on a direct line between the two places.

New Mexico

Grant County

Recent developments in the Juniper district, 16 miles north of Silver City, seem to indicate that the region may possess workable deposits of low-grade ore. Conditions are said to be favorable for mining and milling, with a good supply of water and timber.

Eighty-five—It is reported that this company has purchased the Superior mine for $100,000.

Chemung—This company, together with the Savanna company, has been investigating the cost of a motor-truck road from the Burro Mountains to Whitewater on the Santa Fé road.

Socorro County

Ernestine—Engineers are examining this property with a view of purchasing a controlling interest. If the deal is consummated, it will mean much to the district in the way of operations on a larger scale.

Deadwood—Unwatering of the lower levels is about completed. The good ore recently encountered in the third level continues and other development breasts are also producing a good tonnage. Considerable custom ore is being handled in addition to the mine output. The daily ore treatment is about 60 tons.

Oaks—Thirty-four tons of ore were shipped to the Deadwood mill from 20 ft. of development on the Pacific mine. Twenty-one tons were milled from the Johnson mine, extracted in sinking the shaft 18 feet.

Deep Down—A fair tonnage is being sent to the Deadwood mill from the development conducted by leasers.

Treasure Mining & Reduction Co.—There is sufficient ore now broken in the stopes to supply the mill for six months. Development in the lower levels is satisfactory.

Mogollon Gold & Copper Co.—The winze in the Little Charlie tunnel has been sunk 30 ft. in excellent milling ore.

Oregon

Linn County

The district in the vicinity of Foster is about 30 miles from the town, on the north fork of the South Santiam River. Adequate transportation is lacking, and pack horses are used. Both free-milling and base ores are found.

Lawler—This mine and 20-stamp mill was shut down several years ago and is

still idle. It is in the Quartzville camp and is in charge of Mr. Edison, of Gates.

Albany—Some opencut prospecting was done during the winter. The 10-stamp mill is idle. John McChesney, of Albany, formerly interested in the property, states that it is being sold.

Savage—This mine on Nye Creek, four miles south of Quartzville, has been leased to E. Mannd, of Salem, who expects to install a small mill.

Paymaster—Some development will probably be done this summer, at this mine, 1½ miles from the Savage. Good galena ore has been exposed in several places. Lance Stewart, of Gates, is interested.

Paywell—A contract has been let for some development at this mine, 21 miles from Foster. G. B. Whitcomb, of Foster, is manager.

South Dakota

Black Hills District

Evans—A porphyritic high-grade ore has been discovered on this property, near Deadwood, and Manager Forester is pushing development to determine its extent. The property is unusual in the variety of its ores. Some of the ore carries a high percentage of iron pyrite, some zinc and lead; other is typical silicious ore, amenable to cyanidation; some of the shoots are largely free milling, and some of the porphyry can be cyanided to advantage, although in places it, too, carries pyrites. A number of laboratory tests have been made recently, which show that amalgamation, concentration and cyanidation will probably be necessary.

Utah

Juab County

Tintic shipments for the week ended May 16 amounted to 154 cars, as compared to 173 cars for the week preceding. The decrease in shipments is due largely to caving ground at the Iron Blossom, which held back the output.

Eagle & Blue Bell—The new orebody, carrying gold and silver, opened on the 700 level, has been followed for 35 ft. on the strike, and is reported to average $17 per ton.

Iron Blossom—Drifting has been started around the cave, which occurred recently between the 300- and 600-ft. levels of the No. 1 shaft. It will be about a month before the output can be brought to normal. New equipment for the No. 1 workings has been arriving.

Dragon Consolidated—Good progress is being made in the work which is being done through the Black Jack. Small bunches of ore have been encountered in the raise, which is being driven from the 300-ft. level.

Eureka Leasing—Articles of incorporation were filed, May 20. The capitalization is 10,000 shares, par value 10c. W. L. Mangum is president. The company has obtained a six months' lease on the Tetro claim, belonging to the Plutus. Work will probably be started through the 400-ft. level of the Godiva, adjoining, to reach shipping ore, which has been found through other workings.

Chief—Shipments of good ore are being made at the rate of one car per day.

May Day—Ore has been opened on the 1000-ft. level, where work is being done to connect with the orebody developed below the 1000. There is zinc ore on the 400, which it is thought can be marketed at a profit. Shipments average three cars per week.

Salt Lake County

Utah Metal—This company's tunnel, between the Tooele side of the range and Carr Fork, has been driven about 8600 ft., which leaves about 2400 ft. still to be driven. It is thought that the work will be finished during the coming autumn. The Tooele side is in 7400 ft., while the Bingham side has been driven 1200 feet.

Montana-Bingham—The tunnel has between 300 and 500 ft. still to go to reach the Bingham Amalgamated line. Pyrite carrying some copper has been encountered at frequent intervals during the work. The present length is over 800 ft., and progress of 4 ft. per day is being made.

Michigan-Utah—At a recent meeting of the directors, Norman C. Haire was elected president, to succeed Duncan MacVichie, who has resigned from that office and from the executive committee. Mr. MacVichie is still one of the directors. Shipments are being made from the ore that accumulated during the winter. The wagon road up Big Cottonwood was opened May 19, and shipments will be increased. Shipments from the Little Cottonwood side will probably begin soon. Leasers at the City Rocks are stated to have 200 to 300 tons of ore of fair grade ready for shipment.

South Hecla—Work was started, May 8, in extending one of the main tunnels. Ten men are employed. The compressor is reported to be in good condition, and one or two machine drills are in use. These will later be increased to five, so that operations can be undertaken on a more extensive scale.

Summit County

Silver King Coalition—The annual stockholders' meeting was held, May 20, in Salt Lake City. David Keith was re-elected president, and Thomas Kearns vice-president. Shipments of about 600 tons per week are being made.

Ontario—The Mines Operating Co. has started the installation of a cyanide plant to handle the low-grade ore, which has been left as stope filling. The mill will have a capacity of 150 tons per day, and is expected to cost about $125,000. Provisions are being made to increase the capacity, if this is desired later. The company has a 10-year lease on the old Ontario mine, and it is estimated that there are over 500,000 tons of stope filling and low-grade ores available.

Silver King Consolidated—A new underground hoist has been ordered, and is on the way to the mine. Operations are being curtailed at present, on account of bad roads.

Barry-Coxe—Ore is again reported in the face of the tunnel, which is in 175 ft. This point is about 240 ft. from the surface.

Utah County

Mineral Hill—Work will be resumed during the summer. There are 25 claims, on which about 1500 ft. of development have been done. This is largely tunneling. About $20,000 are being raised by assessment.

Mineral Flat—This property adjoins the Mineral Hill, and is also controlled by the Knight interests. The property also adjoins the Pacific, which has a vein of galena ore, and it is thought possible that this vein may extend into Mineral Flat ground.

Wyoming

New Rambler—This mine, on Elk Mountain, which contains platinum in its ore, has been leased for 15 years to J. Thielman, of Merrill, Wis., who has incorporated the Platinum Mining & Milling Co. Twenty men are at work and the concentrating plant will be started soon.

Canada

British Columbia

Bluebird—Lyman Carter, manager, recently let a contract to sink the shaft 200 ft. to the 300-ft. level. At 180 ft. surface water necessitated temporary suspension of work. Good ore has been encountered and sinking will be resumed soon. Equipment includes a 30-hp. boiler and a 6x8-in. hoisting engine.

Center Star—This group, operated by the Consolidated Mining & Smelting Co., of Canada, Ltd., consists of the Center Star, War Eagle, Iron Mask, Idaho, Spokane, Monita, Pilgrim and Red Mountain. The holdings of the Le Roi Mining Co., in Rossland, were added last July. The company recently purchased at auction the Virginia claim, adjoining the Iron Mask, and developed by a 500-ft. shaft and laterals on the 300-ft. level. Drifting has shown good ore on the 13th level of the War Eagle.

Standard—The company is milling 100 tons per day and shipping concentrate and sorted crude ore to the smeltery. Payment of dividends was commenced in April, when $25,000 was distributed among shareholders. Hereafter $50,000 is to be divided monthly, which, on the

$2,000,000 capitalization, will total 30 per cent. per annum. The mine and mill are near Silverton, Slocan Lake.

ONTARIO

Buffalo Union Furnace Co.—This company, a half-mile from the Cordova, has opened the 100-ft. level and has crosscut a body of magnetite, averaging 60% iron and sufficiently low in phosphorus to grade bessemer. The rockhouse, 85 ft. high is nearly completed and is set on rollers ready to be placed over the shaft. The company intends to erect a magnetic concentrating mill at Belleville to treat low-grade ore.

ONTARIO-COBALT

Shipments of ore and concentrates, in tons, from Cobalt for the week ended May 24, and for the year to date, are:

La Rose	31.13	1,279.31
Coniagas	74.05	771.80
O'Brien	.....	263.24
Right of Way	.....	148.60
Chambers-Ferland	32.00	193.60
McKinley-Darragh	38.02	1,020.93
Nipissing	97.17	792.61
Hudson Bay	.....	312.62
Buffalo	.....	412.57
Crown Reserve	28.50	219.43
Cobalt Townsite	.....	505.28
City of Cobalt	.....	145.84
Trethewey	.....	174.19
Colonial	.....	41.60
Kerr Lake	.....	319.66
Cobalt Lake	.....	176.26
Drummond	.....	300.32
Temiskaming	.....	320.64
Beaver	.....	132.34
Wettlaufer	.....	111.21
Provincial	.....	22.22
Casey Cobalt	.....	24.50
Totals	300.87	7,556.47

Nipissing—The new cyanide plant under construction, together with the necessary tramways to various parts of the property will involve an expenditure of approximately $300,000.

Beaver—The first shipment of concentrates from the new mill, amounting to 33 tons, realized about $20,000. The mill is treating about 60 tons of ore per day and there is about half a car of concentrates ready for shipment. Ore is being raised for the mill from four levels, the lowest being 500 ft. At 530 ft. a smaltite vein is being drifted upon.

Crown Reserve—This company has entered into a contract with the government of Saxony to supply six cars of ore, containing an aggregate of 720,000 oz. of silver. The ore will be used in the government smelteries, to grade up the Saxony ores.

ONTARIO—PORCUPINE

Hughes—The directors have decided to install a plant suitable for carrying on the projected development work.

Canadian Tonopah—This company, at Larder Lake, has ordered a 5-drill compressor.

Three Nations—The directors are visiting the property and will decide whether to build a mill.

Iroquois—This property has been acquired by New York men.

Dome—All work except that which is urgently necessary will be suspended on Sundays.

West Dome—All work has been suspended until the power companies can supply electricity. This will probably be in November. The shortage of fuel is given as the reason for closing.

Gosselin—Trenching on this West Shining Tree property has opened a new vein said to be better than anything yet found in the district.

Dome Lake—The plans for the stamp mill, for which excavations are now being made, provide for 10 stamps, to be operated with tube grinders, giving a total capacity of 100 tons of ore per 24 hr. At 100-ft. depth the main vein shows over 4 ft. in width of good ore. A body of ore sufficient to supply the mill for one year has been blocked out.

Rea—Work will be resumed soon at this mine. If the shareholders are unable to raise funds by a loan or an additional issue of stock, the property will probably be leased.

Crown Chartered—At the Davidson property, the orebody at the 100-ft. level has been drifted on for 30 ft., showing good ore in both faces, with a crosscut 20 ft. in pay ore.

ONTARIO—SUDBURY

Miller—This syndicate has one diamond-drill at work on the Cryderman claim, in Falconbridge township, and two on the Murry property. It is rumored that results so far have been good and that the second payment on the Murry mine has been made.

Moose Mountain Co.—Lack of power has somewhat delayed construction on the new Gröndal magnetic separation plant, but the first unit is now about completed while work on the pumping station, at Vermilion River, is being actively pushed.

Mond—The Froude shaft is down about 180 ft., nearly as far as that of the Canadian Copper Company. The foundations of the new smeltery buildings are completed.

Dominion Nickel-Copper Co.—This company has one diamond drill at work at the Gertrude mine, which it recently bought from the Lake Superior Corporation.

Mexico

CHIHUAHUA

Promontorio—This mine, of the Cusi Mining Co., is reported to have developed considerable low- and medium-grade ore. The erection of a mill is planned and plans and estimates have been completed. C. R. Watson is manager.

MEXICO

Esperanza—During April, the mill crushed 16,081 tons of ore. Total receipts were $105,575; working expenses, $74,710; estimated profit, $23,624. Development totaled 645 ft. Drifting, raising and sinking on the San Carlos vein opened ore running from $8 to $37 per ton.

SONORA

Sonora Mining & Smelting Co.—According to press reports, the property is being worked. The 100-ton smeltery is completed and will be blown in soon. A 3500-ft. aërial tram takes the ore from the mine to the smeltery. The water-jacketed furnace was built by the El Paso Foundry & Machine Co. Arrangements are under way to run a spur from the Southern Pacific Ry. station, three miles to the plant. Mine development is below water level, at 920 ft. depth. Another shaft is to be sunk. A. M. Conara, Noria, is in charge.

Manhattan Exploration Co.—This company has ceased operations at its property on the Yaqui River, near Alamos.

Yaqui River Consolidated Copper Co.—This company is reported to be meeting with some success at its mine east of Imures, in the Magdalena district.

Ritchfield—The new smeltery is said to have been completed, but it is unlikely that operation will start under the present unsettled conditions. The property is 45 miles east of Querobabi.

Greene-Cananea—It is planned to increase the converter capacity.

West Coast Smelting Co.—This company, operating west of Carbo, about 40 miles from the Gulf coast, is planning the erection of a 500-ton smelting plant. It is financed by Holland capital and extensive developments have been under way for about two years. A railroad to the Gulf of California is projected.

South America

CHILE

Braden—A large orebody is said to have been indicated in the Teniente mine. The 3000-ton concentrator is two-thirds completed and operating and is expected to be completed by autumn. This will mean an increased production.

Asia

CHOSEN

Oriental Consolidated—During March, 24,295 tons of ore were crushed, yielding $145,680 gross and net $72,678. Operating costs were $65,207 and $7794 were put back into improvements, development, etc. The Kuk San Dong 40-stamp mill was hung up the full month because of labor shortage.

The Market Report

Current Prices of the Metals, Minerals, Coal and Mining Stocks

Coal Trade Review

New York, May 29—Most of the anthracite collieries are at work by this time and coal is going forward. In the tidewater markets the domestic requirements, which, of course, are light at this season, are generally being filled but there is a scarcity of the steam sizes and it will take some time to meet the demand fully. The Lake trade is beginning to make some demands and considerable shipments are being made westward to Buffalo. There is a little confusion yet about tidewater prices. It is assumed that there is to be an advance which has been stated at 25c. a ton on prepared sizes including pea coal, but the schedules do not seem to be fixed as yet.

The anthracite operators have chosen as their representatives on the Conciliation Board under the new agreement, S. D. Warriner, of the Lehigh Valley, W. L. Richards, of the Reading, and W. L. Connell, an independent operator.

The Seaboard bituminous trade is dull; prices are unsettled and inclined to be low. There is still a surplus of coal at tide and apparently it is going to take some time to work it off.

The coal trade in the West is rather heavy, though the demand for steam coal is reported good. Lake trade is moving rather slowly. There are plenty of boats ready, but coal does not arrive at the ports as freely as might be expected. The West Virginia movement is rather slow.

The United States Supreme Court has decided that the Ohio Railroad Commission had no right to fix rates on Ohio coal intended for shipment up the Lakes, since such shipments come clearly under the head of Interstate business and the rates are under the jurisdiction of the Interstate Commerce Commission.

Coal and coke carried on Pennsylvania R.R. lines east of Pittsburgh and Erie, four months ended April 30, short tons:

	1911	1912	Changes
Anthracite	4,166,812	3,579,602	D. 587,210
Bituminous	13,303,935	15,461,920	I. 2,157,985
Coke	3,639,874	4,190,832	I. 550,958
Total	21,110,621	23,232,354	I. 2,121,733

Total increase this year, 10.1%. The decrease in anthracite was entirely in April, when the quantity carried was only 290,865 tons, against 1,178,787 last year.

Iron Trade Review

New York, May 29—The conditions of active demand and full work at mills still prevail, and there is even some talk of premiums being paid for early deliveries. The mills report heavy specifications on contracts while a fair quantity of new business continues to come in. The majority of the Steel Corporation mills are being operated at 90% of capacity or over, while the leading independents report, most of them, 95%, or practically full capacity. The price advances made in April are well held and some further increases have been made. There is still, however, some shading on structural steel and two or three large contracts are known to have been taken at low rates by the fabricators. The latest advance noted is of 10c. a box or $2 a ton on tinplates. A further advance is expected owing to the high price of tin. Sheets are in heavy demand and some of the mills find difficulty in getting sheet bars as fast as they need them. Structural steel is again in active demand and a number of contracts, both large and small, have been let.

In pig iron the demand is good although most large users have covered their wants up to the end of July and a number of them also through the third quarter. In eastern territory foundry requirements are large, both in large and small lots, and there is a special demand for Nos. 3 and 4 foundry and forge for the cast-iron pipe makers. In the Central West some large lots of both bessemer and basic pig have been taken by some of the large steel companies whose own furnaces are unable to supply the demand.

The taking of testimony in the Steel Corporation suits is still going on. Most of the evidence has again this week related to the condition of affairs at and prior to the time of the organiation of the corporation. The evidence has brought out little or nothing that has not been already known.

During the four months of the present year, from Jan. 1 to May 1, the *Railway Age Gazette* has reported orders for 62,464 freight cars, 1067 passenger cars and 1476 locomotives. For the entire calendar year 1911 the orders as reported amounted to 133,117 freight cars, 2623 passenger cars and 2850 locomotives. In the case of freight cars and locomotives, therefore, the orders placed in the first one-third of 1912 amount to about one-half of those for the entire year 1911; and in the case of passenger cars the number is larger in proportion than for last year.

Baltimore

May 27—Exports for the week included 742,000 lb. steel rails, 575 bundles rail joints and 928,000 lb. steel billets to Glasgow. Imports included 5500 tons manganese ore from Brazil; 9477 tons pyrites from Huelva, Spain; 28,300 tons iron ore from Cuba.

Birmingham

Birmingham, May 27—Pig-iron quotations in Southern territory are firm at $11@11.50, No. 2 foundry, and some selling, though in small lots, is still reported. The greater bulk of the business for delivery during the third quarter of the year has been placed and considerable tonnage has already been engaged for the last three months of the year. The manufacturers are inclined to hold $11.25 per ton, No. 2, as the minimum, for iron to be delivered during the last quarter, and, in some instances, small lots of iron have been sold at $11.50. The manufacturers in the South, because of the strong demand for the lower grades of iron, have been making effort to make the differential prices 25 instead of 50c. In some instances, it has been necessary to consider offers of business for the lower grades carefully, the orders on books already requiring a large proportion of the probable make. The cast-iron pipe makers have been in the iron market most liberally, the expectations being there will be need for a steady operation of the various pipe works not only through the balance of the present year, but into next year. Delivery on orders for pipe placed some time back is being requested, and the production is to be increased just as soon as possible. The melt on the part of the pipe makers in the South is proving of great value in the iron market. There is still some activity with the machine shops and foundries, and the reports from that branch of the industry are encouraging. It has been necessary of late to run the steel-rail mill of the Tennessee company's plant a little overtime, a few small orders requiring immediate delivery. There are hopes of an improving demand for rails, so that the mill at Ensley, Ala., can be assured of steady operation all through the summer. Fabricated steel is in strong demand.

Chicago

May 28—The iron market is quiet as regards the demand for pig iron and busy as regards the demand for manufactured products. Mills in this district are crowded with orders, the requirements showing a rapid expansion of manufacturing and construction needs. Under these circumstances pig iron remains firm, though sales are not in more than carload to 300-ton lots. Furnace agents are well sold up for the production of the next three months. On last-half deliveries, pig iron is held at more than most melters care to pay now for it, so the business resolves itself into small though numerous sales for third-quarter or earlier deliveries.

Northern No. 2 brings in general $14.50@15 at furnace, and Southern No. 2 brings $11@11.50, Birmingham, or $15.35@15.85, Chicago, with the higher prices obtaining on deliveries in the last quarter or last half. Lake Superior charcoal iron is a trifle weaker and brings $15.75@16.25 per ton.

Railroad supplies are being bought more heavily, with rail orders increasing and in prospect and track fastenings active. Structural material has a good and increasing sale for bridge and building purposes throughout Western as well as local territory, at 1.43c. for material up to 15 in. Bars are active, with the local mills getting the business at firm prices, iron bars selling for 1.25c. and soft-steel bars for 1.38c. base. Plates also are in large demand at 1.43c. for ¼-in. tank plates. Sheets and wire products are in better demand than for several weeks. General business conditions are good.

Cleveland

May 27—The iron-ore movement has become active and many cargoes are coming down.

Pig Iron—Orders are coming in freely. Prices have not advanced, but are very firm, and some furnaces are asking more for iron. Quotations, Cleveland delivery, are $15.15 for bessemer, $13.25 for No. 2 foundry, $12.75 for forge and $15.50 for Lake Superior charcoal.

Finished Material—Specifications are coming in freely, and new orders are increasing. Bars are in demand, and plates are active. Steel billets are scarce, and some good orders have been placed with local plants.

Philadelphia

May 29—Comparatively little pig iron was sold during the past week. New York and New Jersey buyers have purchased a few lots, with small inquiries from New England sources. Furnace production has been increasing so much faster than deliveries call for as to make possible a little accumulation of stock. A large sale of steel iron has been made within a day or two for Western delivery. Other transactions are pending from the same quarter, but for smaller quantities. There is further activity in forge iron, most of it for early delivery. No. 2 foundry is again dragging, but makers are holding firmly to reeent advances. Basic and bessemer are strong and with an excellent outlook. Low-grade irons are selling well, but Southern furnaces seem to control that branch of the trade. Prices will no doubt remain where they are until some new development occurs in the market. The opinion of furnace men and brokers is that the crude-iron situation will steadily improve.

Steel Billets—Billets are advancing in price and large lots have recently changed hands in this territory. Premium prices are likely to prevail to urgent buyers whose judgment has been on the wrong side of the market for several weeks.

Bars—Prices have fractionally advanced for early deliveries, which are the chief features of present inquiry. Both large and small buyers are looking for summer and fall stocks.

Sheets—The sheet mills of this district are running to nearly full capacity and prices are in the upward way. It looks as though an advance would be announced in a few days, but definite information is not to be obtained.

Pipes & Tubes—The demand for pipe is exceptionally large and tubes have advanced, especially in seamless. Merchant pipe will soon advance and in anticipation some orders are being placed.

Plates—A large business has been done in iron and steel plate, especially on car-building account. Inquiries are crowding in and buyers requiring earlier than 60 days' delivery are not finding it easy to be accommodated. Mills are crowding their capacity to get ready for new work which is likely to be offered.

Structural Material—Orders for structural material have been crowding in within a few days and our territory capacity is now pretty well sold up.

Scrap—The heavy supplies of scrap which have recently been gathered by the larger dealers have already been disposed of to early buyers who paid good prices.

Pittsburgh

May 28—In general, there has been noticed a slight falling off in new business in the past fortnight, and this is particularly marked in the past week. Specifications upon contracts, however, keep up very well indeed, and are probably as heavy as at any time. In bars, plates and shapes they are so heavy that the mills are now confident they can maintain full operation until November. Most of the mills are definitely behind in deliveries on these products, being unable to ship as promptly on new specifications as buyers would desire. In other lines specifications are not on books in as large volume, but in all of them the volume of business is good and the whole market situation is regarded as satisfactory.

The mills are deriving less benefit from week to week by reason of the advanced prices than is generally estimated. While the very lowest priced business has been worked off to an extent, there is still much low priced business under contract, while the sales at the present advanced prices have been relatively light. Some products, it must be remembered, have not advanced at all, and it is improbable that the steel mills as a whole will realize an advance of more than $1 a ton on their second-quarter shipments as compared with the first quarter.

The strongest item on the list, the one in which mills are farthest behind, is universal mill plates, merchant bars coming next, plates third, and shapes, sheets, tinplates, etc., about the middle, while tubular goods are relatively slack and wire products are almost absolutely stagnant. The wire-product market is if anything weaker than 30 days ago, and rods can be bought at a cut from $25, a price formerly well maintained.

Pig Iron—The market has been almost stagnant. There is occasional figuring on bessemer and basic iron, the Steel Corporation in particular having had some negotiations, but there are few purchases. Foundry pig iron is dead, and the situation is a curious one in that furnaces are well sold up and it would require only a slight increase in demand to send the market up several notches, since idle furnaces will not, on account of the high price of coke, get into blast except upon quite a good advance. A peculiar feature of the situation is that a great deal of foundry iron has been sold for second-half delivery at $13.50, Valley, yet with the second half only five weeks away prompt foundry iron is bringing only $13.25, Valley. We quote: Bessemer, $14.25; basic, malleable and forge, $13; No. 2 foundry, $13.25@13.50, all f.o.b. Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—The market is quiet. Occasional small lots, less than carloads, frequently bring well above $50, Baltimore, but carload and larger lots can be had at about that figure. For second half the regular price remains $48.50, Baltimore.

Steel—In some quarters it appears that sheet bars are a trifle easier, but this is probably only by comparison, some fictitious prices having been named in the past few weeks as representing the market. Small billets are scarce, and command, as formerly, a full dollar above 4x4 billets, while occasionally a larger premium is obtained. In one or two exceptional cases sales of small billets have been made at $23, f.o.b. mill, Pittsburgh. We continue to quote, f.o.b. maker's mill,

Pittsburgh: Billets, $20.50@21; sheet bars, $21@21.50, with prices f.o.b. maker's mill, Youngstown, about 50c. less. Rods are regularly quoted at $25, Pittsburgh, but this price could be shaded about 50c. on an order at all attractive.

Sheets—The market shows no material change, and the prices of the leading interest continue to be cut, although it is booking considerable business at its minimum. We continue to quote: Black, 28 gage, 1.90@1.95c.; galvanized, 2.95@3c.; blue annealed, 10 gage, 1.40c., the higher price being that of the leading interest.

St. Louis

May 27—Business continues good in the pig-iron market; no large orders are reported this week but a number of small sales make up a large total. Southern No. 2 foundry is quoted at $11.25@11.50, Birmingham, or $15@15.25, St. Louis, the higher prices being for July or later delivery. Northern iron is in less demand and is quoted about $15 for No. 2 foundry.

The demand for finished products of all kinds continues good and local mills are busy. Coke is quoted at $5@5.10, St. Louis, for Connellsville foundry, with supplies rather short.

Iron Ore Trade

The Lake Shore, the Erie, the Pennsylvania company and the Cincinnati, Hamilton & Dayton, have filed tariffs with the Interstate Commerce Commission, fixing the unloading rates at their Lake Erie docks at 10c. per ton on iron ore. The Pennsylvania R.R., the Baltimore & Ohio and the Pittsburgh & Lake Erie have not yet filed their schedules, and they may be somewhat lower. The rate on iron ore from the ports to the Pittsburg district is fixed at 96c.; to Youngstown, 56c. per ton.

Some small sales of Spanish ore are reported on the basis of 7c. per unit, delivered to furnaces in eastern Pennsylvania.

British Iron and Steel Trade

Exports and imports of iron and steel, and of machinery, in Great Britain, four months ended Apr. 30, are valued by the Board of Trade returns as below:

	Exports	Imports	Excess
Iron and steel	£15,007,223	£3,683,797	Ex. £11,323,426
Machinery	10,370,236	2,214,538	Ex. 8,155,698
Cutlery and hardware	4,039,416	2,654,004	Ex. 1,385,412
New ships	1,716,933	.....	Ex. 1,716,933
Total	£31,133,808	£8,552,339	Ex. £22,581,469
Total, 1911	29,881,007	7,898,862	Ex. 21,982,145

Increase in exports this year, £1,252,801; increase in imports, £653,477. The quantities of iron and steel were, in long tons:

	1911	1912	Changes
Exports	1,475,674	1,574,918	I. 99,244
Imports	445,951	459,239	I. 13,288

Tinplate exports to the United States decreased from 8369 tons in 1911 to 703 tons this year.

Metal Markets

New York, May 29—The metal markets have been generally active, with some advances in price.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal	Exports	Imports	Excess
Gold			
Apr. 1912	$ 1,816,816	$ 3,892,599	Imp. $2,075,783
" 1911	1,505,634	4,524,835	Imp. 3,019,201
Year 1912	21,774,902	16,306,794	Exp. 5,468,108
" 1911	3,364,658	23,990,572	Imp. 20,625,914
Silver			
Apr. 1912	4,941,259	4,189,512	Exp. 751,747
" 1911	7,610,154	4,251,532	Exp. 3,358,622
Year 1912	21,897,247	16,039,732	Exp. 5,857,515
" 1911	23,611,196	14,898,313	Exp. 8,712,883

Exports from the port of New York, week ended May 25: Gold, $339,050, chiefly to Argentina; silver, $1,464,997, chiefly to London, except $366,000 direct to Bombay. Imports: Gold, $392,747; silver, $81,056, largely from Mexico.

Gold—The price of gold on the open market in London continues at the usual rate, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. With the exception of £500,000 for India, and £50,000 for Egypt, supplies arriving were taken by the Bank of England.

Iridium—This metal continues unchanged, the current price being $64 per oz. New York.

Platinum—The market is rather quiet and very little is being taken just now by the jewelers. There is apparently little or no surplus, however, and dealers continue to ask $45.50 per oz. for refined platinum and $48 per oz. for hard metal. The market abroad is reported a little easier.

Silver—The undertone in the market continues good. Tendency will be governed a good deal by the monsoon prospects of the coming summer. The offtake at Bombay, which had risen to 140 bars per day, has now materially been reduced.

SILVER AND STERLING EXCHANGE

May	23	24	25	27	28	29
New York	61	60¾	61⅛	61	61	61
London	28 1/16	28	28⅛	....	28⅛	28 1/16
Sterling Ex.	4.8715	4.8715	4.8720	4.8720	4.8720	4.8720

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver. 0.925 fine.

Exports of silver from London to the East, Jan. 1 to May 16, as reported by Messrs. Pixley & Abell:

	1911	1912	Changes
India	£3,457,600	£2,588,800	D. £868,800
China	822,800	630,000	D. 192,800
Total	£4,280,400	£3,218,800	D. £1,061,600

Exports of gold from Great Britain to India in April, £739,865 in 1911, and £762,160 in 1912; exports, four months ended Apr. 30, were £4,607,150 in 1911, and £7,088,315 this year.

Copper, Tin, Lead and Zinc

NEW YORK

May	Copper: Lake, Cts. per lb.	Copper: Electrolytic, Cts. per lb.	Tin: Cts. per lb.	Lead: New York, Cts. per lb.	Lead: St. Louis, Cts. per lb.	Zinc: New York, Cts. per lb.	Zinc: St. Louis, Cts. per lb.
23	16¼ @16¾	16.30 @16.40	45⅜	4.20	4.07½ @4.10	6.70 @6.75	6.55 @6.60
24	16¼ @16¾	16.30 @16.40	46¼	4.20	4.10 @4.12½	6.70 @6.75	6.55 @6.60
25	16¼ @16¾	16.30 @16.40	46¼	4.20	4.10 @4.12½	6.70 @6.75	6.55 @6.60
27	16¼ @16¾	16.35 @16.45	46⅝	4.20	4.10 @4.12½	6.70 @6.75	6.55 @6 60
28	16¼ @16¾	16.45 @16.50	47⅛	4.20	4.10 @4.12½	6.70 @6.75	6.55 @6.60
29	16¼ @16¾	16.50 @16 55	45½	4.20	4.10 @4.12½	6.70 @6.75	6.55 @6.60

The quotations for copper, lead, spelter and tin are for wholesale contracts with consumers, without distinction as to deliveries; and are representative, as nearly as possible, of the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. and that for casting copper usually about 0.125 to 0.2c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium.

LONDON

May	Copper: Spot	Copper: 3 Mos	Copper: Best Sel'td	Tin: Spot	Tin: 3 Mos	Lead, Spanish	Zinc, Ordinaries
23	73 11/16	74 1/16	79	204¾	200¾	16⅛	25⅞
24	74	74 1/16	79	208⅛	201⅝	16 1/16	25⅞
25	.....	.....	.....	.....	.....	.....	.....
27	....	....	....	....	.....	....	....
28	74⅝	75⅛	79¾	214	202	16 1/16	25⅞
29	75⅝	76⅛	80¾	206⅛	199⅛	16 1/16	25⅞

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c.; £25 = 5.44c.; £70 = 15.22c. Variations, ± £1 = ± 21¾c.

Copper—During the week of May 23-29, the business in copper has been rather light, the holidays in Europe having suspended the demand from there, but a fair tonnage of electrolytic copper has been placed with domestic consumers. During the first three days, this was done at 16½c., delivered, usual terms, and 16.35c., cash, New York, which is the same thing. During Monday the agencies generally raised their price to 16⅝c., delivered, usual terms, and by the end of the day this was realized. On Tuesday the market was fully on that basis, and at the end of that day one of the agencies advanced its price asked to 16¾c., delivered, usual terms. Some of the sell-

ers of Lake copper have complained of the relative slackness in the demand for that kind of metal. Some moderate sales are reported at 16⅝c., and small quantities at a little above and below that figure. Some of the sellers of electrolytic claim to have booked all their July metal. The market of this week has been chiefly in July-August, with a little running into September. Consumption continues excellent. Production has been somewhat interfered with by strikes at certain of the refineries, which probably has been a factor in the market. These now seem to have been settled. At the close, Lake copper is quoted at 16½@16¾c., and electrolytic copper in cakes, wirebars and ingots at 16.50@16.55c., while casting copper is quoted nominally at 16.20@16.30c., as an average for the week.

The London standard market has been strong and advancing. The bears have come to recognize that the intrinsic position of the metal is too strong to continue their position, and there has been considerable bear covering, in addition to which there has been renewed bull speculation. In consequence, prices have advanced, and at the close spot is quoted at £75 12s. 6d. and three months at £76 2s. 6d. per ton.

Copper sheets have been advanced to 21½@22½c. per lb., base for large lots. Full extras are charged and higher prices for small quantities. Copper wire is 17½c. base, carload lots at mill.

Copper exports from New York for the week were 11,205 long tons. Our special correspondent gives the exports from Baltimore at 1324 tons.

It is reported that the Katanga copper recently sold in Antwerp analyzed: Cu, 89 to 90%; Co, 4.5 to 5; Fe, 0.30 to 2; S, 0.50 per cent.

Tin—Up to Tuesday of this week, the London market ruled firm on good-sized orders which were placed from this side for June delivery. On Tuesday, spot tin in London advanced almost £6 over its close on Friday, while future tin only improved to the extent of 10s. per ton. This movement was ascribed to depleted stocks in London warehouses, and the inability, due to London dock strikes, to unload promptly arrivals from the East.

Buying in this market centered on June deliveries, while, after the rapid advance in London, a disposition among dealers was shown to sell July-August deliveries at a discount. At this writing, the London market has again declined as abruptly as it advanced, and the close is weak at £206 10s. for spot, and £199 10s. for three months.

Lead—The market is firm. New York lead is quoted at 4.20c., while lead at St. Louis is somewhat higher at 4.10@4.12½ cents.

The London market is unchanged at £16 11s. 3d. for Spanish lead, and 2s. 6d. higher for English.

Spelter—A fair tonnage of July-August metal has been turned over at an average of 6.55@6.60c., St. Louis. There has been but little demand for June delivery, but on occasional carloads of spot metal fancy premiums have been realized. Speaking generally, the market is quiet, and without special feature. St. Louis is quoted at 6.55@6.60c., and New York at 6.70@6.75 cents.

The London market for good ordinaries is quoted at £25 17s. 6d., and specials £26 2s. 6d. per ton.

Base price of zinc-sheets is $8.65 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

Zinc dust is quoted at 7⅛c. per lb., New York, in carload lots.

Other Metals

Aluminum—Trade in New York is still rather dull at the recent advances. There are still some lots imported at low prices in second hands, but these are gradually disappearing. We quote 21½@22c. per lb. for No. 1 ingots, New York.

It is said that the aluminum convention in Europe has agreed upon £70 per long ton—equal to 15.21c. per lb.—for No. 1 ingots for 1912 delivery. This is equivalent to about 22½c. per lb., duty paid, at New York. A price of £80 for 1913 is proposed.

Antimony—Trade has been on a moderate scale but the outside brands are a little firmer. Cookson's is still held at 8c. per lb. and Halletts at 7¾c.; while Chinese, Hungarian and other outside brands are quoted at 7⅛@7¼c. per pound.

Quicksilver—The market is steady with a fair business doing and prices are unchanged. New York quotations are $41@42 per flask of 75 lb., with 60c. per lb. charged for retail lots. San Francisco, $41.50 for domestic orders and $39 for export. The London price is £8 5s. per flask, with £8 quoted from second hands.

Cadmium—The latest quotations received is 700 marks per 100 kg., f.o.b. works in Silesia, Germany. This is equal to 75.6c. per lb., at works.

British Metal Imports and Exports

Imports and exports of metals in Great Britain, four months ended Apr. 30, figures in long tons, except quicksilver, which is in pounds:

Metals	Imports	Exports	Excess
Copper, long tons	43,455	18,506	Imp. 24,949
Copper, 1911	50,906	26,493	Imp. 24,413
Tin, long tons	16,485	19,165	Exp. 2,680
Tin, 1911	14,367	16,455	Exp. 2,088
Lead, long tons	69,006	15,880	Imp. 53,126
Lead, 1911	67,404	20,972	Imp. 46,432
Spelter, l'g tons	42,641	2,731	Imp. 39,910
Spelter, 1911	40,956	3,352	Imp. 37,604
Quicksilver, lb.	2,342,284	806,923	Imp. 1,535,361
Quicksilver, '11	1,732,639	1,120,898	Imp. 611,741
Minor met's, tons	2,369	8,273	Exp. 5,901
Minor, 1911	1,803	6,684	Exp. 4,884
Ores			
Tin ore and con.	10,071	.....	Imp. 10,071
Tin ore, 1911	9,766	.....	Imp. 9,766
Pyrites	311,388	.....	Imp. 311,388
Pyrites, 1911	328,180	.....	Imp. 328,180

Copper totals include metallic contents of ore and matte. Exports include re-exports of foreign material. Miscellaneous metals include nickel, aluminum and the minor metals and alloys.

Zinc and Lead Ore Markets

Platteville, Wis., May 25—The highest price paid this week for zinc ore was $55; the base price, 60% zinc, was $54 per ton. The base price paid for 80% lead ore was $53 per ton.

SHIPMENTS, WEEK ENDED MAY 25

Camps	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Mineral Point	800,270	.....	.....
Galena	568,700	.....	.....
Benton	485,100	106,180	593,850
Platteville	406,000	50,000	200,000
Cuba City	324,650	.....	109,600
Hazel Green	280,000	.....	.....
Harker	206,330	.....	.....
Shullsburg	197,000	.....	.....
Rewey	80,000	.....	.....
Linden	72,040	.....	.....
Total	3,420,090	156,180	903,450
Year to date	81,620,500	3,082,170	10,505,250

Shipped during the week to separating plants, 1,517,360 lb. zinc ore.

Joplin, Mo., May 25—The high price of zinc sulphide ore this week is $61, the base per ton of 60% zinc is $52@58. Zinc silicate sold at $27@30 per ton of 40% zinc. The average price, all grades of zinc was $54.62. The high price of

SHIPMENTS, WEEK ENDED MAY 25

	Blende	Calamine	Lead Ore	Value
Webb City-Carterville	4,424,830	.....	1,082,260	$153,116
Joplin	2,495,500	.....	265,280	76,771
Duenweg	841,900	.....	.....	23,573
Galena	706,720	.....	72,230	21,628
Miami	442,080	.....	178,350	15,156
Alba-Neck	449,430	.....	57,560	14,529
Oronogo	374,750	.....	.....	10,368
Granby	351,450	43,060	11,860	9,600
Cave Springs	198,010	.....	16,550	6,156
Aurora	159,970	126,210	.....	5,292
Carthage	212,520	.....	.....	5,737
Carl Junction	135,240	.....	.....	4,057
Spurgeon	.....	198,000	12,790	3,290
Jackson	114,250	.....	.....	3,084
Springfield	84,000	.....	.....	2,500
Lawton	62,410	.....	.....	1,747
Badger	62,980	.....	.....	1,574
Quapaw	54,210	.....	.....	1,280
Totals	11,167,250	367,270	1,696,880	$360,058
5 mos	211,970,410	12,825,680	35,206,660	$6,353,361

Blende val., the week, $309,460; 5 mos., $4,205,218
Calamine, the week, 5,538; 5 mos., 187,687
Lead value, the week, 45,060; 5 mos., 960,556

MONTHLY AVERAGE PRICES

Month	Zinc Ore: Base Price		Zinc Ore: All Ores		Lead Ore: All Ores	
	1911	1912	1911	1912	1911	1912
January	$41.85	$44.90	$40.55	$43.54	$55.68	$58.92
February	40.21	45.75	39.16	43.31	54.46	52.39
March	39.85	51.56	38.45	49.25	54.57	54.64
April	38.88	52.00	37.47	50.36	56.37	54.18
May	38.25	.....	36.79	.....	55.21	.....
June	40.50	.....	38.18	.....	56.49	.....
July	40.75	.....	38.36	.....	58.81	.....
August	42.50	.....	41.28	.....	60.74	.....
September	42.63	.....	41.29	.....	59.33	.....
October	42.38	.....	40.89	.....	54.72	.....
November	45.40	.....	43.25	.....	57.19	.....
December	44.13	.....	40.76	.....	62.03	.....
Year	$41.45	.....	$39.90	.....	$56.76	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

lead ore is $56 and the average price all grades, $53.10 per ton.

The zinc-ore market shows a gain of $1 per ton over that of last week. It seemed on Thursday that the same prices were going to rule as last week, but owing to there being no surplus ore in the district prices stiffened and in order to fill orders buyers were compelled to pay a little extra for a few choice lots. The lead market also stiffened, as there was more competition this week than for several weeks past.

Chemicals

New York, May 29—The general market continues to be in a more active condition and a good deal of business is reported.

Copper Sulphate—The volume of business done has been fair. Quotations continue unchanged at $5.25 per 100 lb. for carload lots, and $5.50 per 100 lb. for smaller orders.

Nitrate of Soda—Business is rather quiet but prices continue firm, and have even advanced a little. Spot and June delivery are quoted at 2.42½c. per lb. while 2.40c. are asked for all positions after July.

Arsenic—A good demand continues, as the manufacturers of insect poisons are again in the market to some extent, while spot supplies are not any too large. The current price is $3.75 per 100 lb. for white arsenic. Futures are quoted at $3.50 per 100 lb. but there is not much interest in them.

Potash Salts—Late dispatches from Vienna state that arrangements have been completed to exploit the deposits of potash salts at Kalusz in Galicia, the discovery of which was reported two years ago. A company has been formed with a capital of $2,400,000, which is backed by the Länder Bank of Vienna and the Industrial Bank of Lemberg in Galicia.

Petroleum

The total production of petroleum in Galicia in March was 94,830 metric tons.

The Philippine Bureau of Lands has made a topographical survey of the Tayabas peninsula in the Philippines, and the Division of Mines is to make a geological survey of the district to determine the probability of the existence of petroleum there. About 100 claims have been taken up in the district under the mining law.

Mining Stocks

New York, May 29—On May 23 the Exchange was quieter and more steady, with no marked movement of prices in either direction. The Curb was more active, but mining stocks were in light demand, with few price changes.

May 24 the Exchange was quiet, with few changes and closing firm. The Curb ran chiefly to industrials, but there were fair sales of copper stocks at slight advances. Elizabeth Gold Mines, Ltd., was listed on the Curb, as a prospect. On May 25 trading was light both on the Curb and the Exchange.

May 27 the Exchange was inclined to be dull and without special features. The Curb, on the other hand, was active and interest developed in mining stocks. Trading was large in the copper shares, notably Braden, Giroux and British Columbia, which held about even in price. In the Cobalts, Nipissing declined a little, but La Rose and McKinley-Darragh gained. Motherlode gold and Gold Hill advanced on good sales.

May 28 the Exchange lapsed into dullness, with light trading and few changes. The Curb was less active than on the preceding day, but there was good selling of copper stocks. Braden and Greene-Cananea being most in demand. Cobalt shares were easier, and other mining stocks in moderate demand. On May 29 the markets simply followed the lead of the previous day.

At auction in New York, May 23, the following prices are noted: Green River Coal & Coke Co. $1000 bond, $11; 100 shares Batopilas Mining Co., $1.87½ per share; 50 shares United States Reduction & Refining Co., 2% of par value; New Jersey Zinc Co. 31 7-30400 certificate of beneficial interest, $300; lot including 300 shares Electric Lead Reduction Co.; 500 shares Montreal & Boston Mining Co.; 100 shares Ohio Tonopah Mining Co.; 100 shares Central Foundry Co. pfd. (old company); 100 shares Union Copper Mines Co.; 1200 shares Seattle Coal & Iron Co.; 25 shares Chicago Subway Co. $50 for the lot.

Boston, May 28—This market is in the doldrums and copper shares are all but neglected. True, there have been one or two specialties which have shown activity and advancing prices. Calumet & Arizona went up $4.50 to $76.50 on extra-heavy trading and Ahmeek is selling at a new high record at $320. The spurt of activity in Santa Fe, which pushed the price up from $2.50 to $4.87½, has subsided and the price is back to $3.75, with very light trading. Mayflower and Old Colony "the diamond-drill twins" have also lapsed into dullness and lower prices.

By all odds the most important event that has happened in this market for a long time is the decision rendered by the Supreme Court against A. S. Bigelow in the suit brought by the Old Dominion. It caused the price of the receipts to jump from $3.50 to $9, with no sales between the first named price and $7.50 on the Curb, where they are traded in. It is estimated that the amount of the verdict, less lawyers' fees and various other expenses, will yield anywhere from $8 to $12 per share for the 150,000 shares entitled to participate.

COPPER PRODUCTION REPORTS.

Copper contents of blister copper, in pounds

Company	Feb.	March	April
Alaska shipments.	2,662,243	4,987,916	1,243,911
Anaconda	27,450,000	25,900,000	25,480,000
Arizona, Ltd.	3,020,000	3,150,000	3,400,000
Copper Queen	6,046,860	7,197,121	.....
Calumet & Ariz.	4,452,004	4,652,000	4,104,000
Chino	950,000	1,108,381	.....
Detroit	2,068,370	2,246,238	.....
East Butte	1,440,000	1,480,000	.....
Mammoth	1,722,954	1,939,310	1,718,450
Mason Valley	1,100,000	1,140,000	.....
Nevada Con.	4,888,790	6,380,000	6,115,095
Old Dominion	2,039,000	2,432,000	2,167,000
Ray	2,140,000	2,300,000	2,612,500
Shannon	1,300,000	1,388,000	1,544,000
South Utah	283,838	299,000	284,215
United Verde*	2,250,000	2,250,000	.....
Utah Copper Co.	8,612,739	8,160,000	8,615,775
Lake Superior*	19,000,000	19,750,000	18,250,000
Non-rep. mines*	7,050,000	7,291,619	8,250,000
Total production.	98,476,798	104,051,585	.....
Imports, bars, etc.	18,976,513	23,519,215	.....
Total blister	117,453,311	127,570,800	.....
Imp. in ore & matte	10,432,438	8,736,874	.....
Total	127,885,749	136,307,674	.....
Miami	2,475,996	2,755,000	2,554,352
Brit. Col. Cos.:			
British Col. Copper	860,003	.....	.....
Granby	1,773,496	1,882,073	.....
Mexican Cos.:			
Boleo	2,204,720	2,424,800	2,149,280
Cananea	2,948,000	2,834,000	4,654,000
Moctezuma	2,687,712	2,446,731	.....
Other Foreign:			
Cape Cop., S. Africa	786,440	725,760	954,240
Kyshtim, Russia	1,055,000	.....	1,545,000
Spassky, Russia	649,600	638,400	649,600
Famatina, Argen.	.....	.....	.....
Tilt Cove, Newf'd.	109,059	104,992	119,869
Exports from:			
Chile	6,720,000	3,584,000	6,496,000
Australia	7,164,000	8,064,000	9,408,000
Arrivals in Europe†	10,868,680	12,559,680	12,064,640

Figures are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

*Estimated. †Does not include the United States, Australia or Chile.

Chino, January, 1,050,000.

STATISTICS OF COPPER.

Month	United States Product'n	Deliveries, Domestic	Deliveries for Export
IV, 1911	118,085,223	52,407,650	62,129,599
V	126,962,544	64,543,963	61,978,557
VI	124,554,312	61,655,561	71,460,519
VII	112,167,934	56,982,582	74,880,658
VIII	125,493,667	59,935,364	69,855,660
IX	115,588,950	57,311,584	50,824,011
X	118,255,442	64,068,307	60,084,349
XI	111,876,601	68,039,776	67,049,279
XII	122,896,697	65,988,474	79,238,716
Year	1,431,938,338	709,611,605	754,902,233
I, 1912	119,337,753	62,343,901	80,167 904
II	116,035,809	56,228,368	63,148,096
III	125,694,601	67,487,466	58,779,566
IV	125,464,644	69,513,846	53,252,326

VISIBLE STOCKS

	United States	Europe	Total
V, 1911	165,555,908	212,284,800	377,840,708
VI	165,995,932	202,540,800	368,536,732
VII	157,434,164	195,932,800	353,366,964
VIII	137,738,858	191,891,840	329,630,698
IX	133,441,501	191,228,800	324,670,301
X	140,894,856	191,945,600	332,840,456
XI	134,997,642	176,825,600	311,823,242
XII	111,785,188	164,281,600	276,066,788
I, 1912	89,454,695	158,323,200	247,777,895
II	66,280,643	154,851,200	221,131,843
III	62,939,988	141,142,400	204,082,388
IV	62,367,557	136,819,200	199,186,757
V	65,066,029	134,176,000	199,242,029

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month.

Davis Daly was the most active Curb feature during the week, advancing to $3.12½, or almost $1. Boswyocolo and Laramie had bad times on the Curb, the former breaking from 8 to 4c., and the latter from 90 to 45c. per share.

Assessments

Company	Delinq	Sale	Amt
Alpha Con., Nev	May 29	June 19	$0.05
Andes, Nev	May 28	June 18	0.05
Best & Belcher, Nev	June 3	June 27	0.10
Black Horse, Ida	..	...	0.02
Black Jack, Utah	Feb. 5	...	0.01
Caledonia, Nev	May 21	June 11	0.10
Cedar-Talisman, Utah	Apr. 20	...	0.005
Challange, Nev	June 8	June 11	0.10
East Tintic, Utah	May 30	June 25	0.005
Ely Con., Nev	...	...	0.05
Exchequer, Nev	May 23	June 13	0.05
Federal Ely, Utah	May 8	June 8	0.01
Glen Dale, Utah	May 25	June 25	0.00
Houghton Copper, Mich	May 17	...	1.00
Julia, Nev	May 15	June 5	0.05
Lehi Tintic, Utah	Feb. 29	...	0.01
Lower Mammoth, Utah	Mar. 16	...	0.01
Michigan Cop. & Gold, Utah	May 15	May 30	0.002½
New York Bonanza, Utah	May 8	...	0.02
Ojibway, Mich	Jan. 10	...	1.00
Raven, Mont	Feb. 1	...	0.10½
Savage, Nev	June 4	June 26	0.105
Segregated Belcher, Nev	June 1	June 28	0.05
South Lake, Mich	June 3	...	2.00
Southwestern Miami, Ariz	Jan. 15	...	1.00
Tintic Central, Utah	June 14	July 6	0.005
Union Con., Nev	May 9	May 31	0.15
Utah Antimony, Utah	June 1	...	0.03

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1910	1911	1912	1910	1911	1912
January	52.375	53.795	56.260	24.154	24.865	25.887
February	51.534	52.222	59.043	23.794	24.081	27.190
March	51.454	52.745	58.375	23.690	24.324	26.875
April	53.221	53.325	59.207	24.483	24.595	27.284
May	53.870	53.308	...	24.797	24.583	...
June	53.462	53.043	...	24.651	24.486	...
July	54.150	52.630	...	25.034	24.286	...
August	52.912	52.171	...	24.428	24.082	...
September	53.295	52.440	...	24.567	24.209	...
October	55.490	53.340	...	25.596	24.594	...
November	55.635	55.719	...	25.680	25.649	...
December	54.428	54.905	...	25.160	25.349	...
Year	53.486	53.304	...	24.670	24.592	...

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

	New York				London, Standard	
	Electrolytic		Lake			
	1911	1912	1911	1912	1911	1912
January	12.295	14.094	12.680	14.337	55.600	62.760
February	12.256	14.084	12.611	14.329	54.974	62 893
March	12.139	14.698	12.447	14.868	54.704	65.884
April	12.019	15.741	12.275	15.930	54.034	70.294
May	11.989	...	12.214	...	54.313	...
June	12.385	...	12.611	...	56.365	...
July	12.463	...	12.720	...	56.673	...
August	12.405	...	12.634	...	56.266	...
September	12.201	...	12.508	...	55.253	...
October	12.189	...	12.370	...	55.170	...
November	12.616	...	12.769	...	57.253	...
December	13.552	...	13.768	...	62.068	...
Year	12.376	...	12.634	...	55.973	...

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN AT NEW YORK

Month	1911	1912	Month	1911	1912
January	41.255	42 529	July	42 400	...
February	41 614	42.962	August	43 319	...
March	40.157	42.577	September	39 755	...
April	42.185	43.923	October	41.185	...
May	43.115	...	November	43.125	...
June	44.606	...	December	44.655	...
			Av. Year	42.281	...

Prices are in cents per pound.

LEAD

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	4.483	4.435	4.334	4.327	13 009	15.619
February	4.440	4.026	4.266	3 946	13.043	15 738
March	4.394	4.073	4.238	4.046	13.122	15.997
April	4.412	4.200	4.262	4.118	12.889	16.331
May	4.373	...	4.223	...	12.984	...
June	4.435	...	4.292	...	13.260	...
July	4.499	...	4.397	...	13.530	...
August	4.500	...	4.406	...	14.260	...
September	4.485	...	4.356	...	14.744	...
October	4.265	...	4.139	...	15.332	...
November	4.298	...	4.181	...	15.821	...
December	4.450	...	4.332	...	15.648	...
Year	4.420	...	4.286	...	13.970	...

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	5.452	6.442	5.302	6.292	23.887	26.642
February	5.518	6.499	5.368	6.349	23.276	26.661
March	5.563	6.626	5.413	6.476	23.016	26.048
April	5.399	6.633	5.249	6 483	23.743	25.644
May	5.348	...	5.198	...	24.375	...
June	5.520	...	5.370	...	24.612	...
July	5.695	...	5.545	...	25.006	...
August	5.953	...	5.809	...	26.801	...
September	5.869	...	5.719	...	27.750	...
October	6.102	...	5.951	...	27.256	...
November	6.380	...	6.223	...	26.795	...
December	6.301	...	6.151	...	26.849	...
Year	5.758	...	5.608	...	25.281	...

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON AT PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1911	1912	1911	1912	1911	1912
January	$15.90	$15.12	$14.40	$13.32	$14.75	$14.00
February	15.90	15.03	14.50	13.28	14.81	14.01
March	15.90	14.95	14.65	13.66	14.96	14.10
April	15.90	15.13	14.65	13.90	15.00	14.15
May	15.90	...	14.30	...	14.72	...
June	15.90	...	14.06	...	14.56	...
July	15.90	...	14.03	...	14.53	...
August	15.90	...	14.00	...	14.47	...
September	15.90	...	13.57	...	14.40	...
October	15.43	...	13.44	...	14.34	...
November	14.92	...	13.30	...	14.25	...
December	15.15	...	13.10	...	13.90	...
Year	$15.72	...	$13.94	...	$14.49	...

STOCK QUOTATIONS

SAN FRANCISCO May 28

Name of Comp.	Clg.	Name of Comp.	Bid
COMSTOCK STOCKS		MISC. NEV. & CAL.	
Alta	.10	Belmont	10.00
Belcher	.59	Jim Butler	.55
Best & Belcher	.05	MacNamara	.18
Caledonia	1.30	Midway	.59
Challenge Con	.11	Mont.-Tonopah	2.82½
Chollar	.05	North Star	.19
Confidence	.65	West End Con	2.17½
Con. Virginia	.83	Atlanta	.26
Crown Point	.61	Booth	.10
Gould & Curry	05	C.O.D. Con	.09
Hale & Norcross	.20	Comb. Frac	.17
Mexican	2 85	Jumbo Extension	.40
Occidental	.55	Pitts.-Silver Peak	1.25
Ophir	1.30	Silver Pick	.13
Overman	1.00	St. Ives	.30
Potosi	.06	Tramp Con	‡.01
Savage	.17	Argonaut	2.00
Sierra Nevada	.23	Bunker Hill	‡4.50
Union Con	.95	Cent. Eureka	.72
Yellow Jacket	.60	So. Eureka	3.00

N. Y. EXCH. May 28

Name of Comp.	Clg.
Amalgamated	82⅛
Am. Agri. Chem	62
Am.Sm.&Ref.,com	85⅛
Am. Sm. & Ref., pf.	107⅞
Am. Sm. Sec., pf. B	88⅜
Anaconda	42⅝
Batopilas Min	1⅜
BethlehemSteelpf	70¾
Chino	30
Comstock Tunnel	‡.10
Federal M. & S., pf.	42
Goldfield Con	4¼
GreatNor.,ore,ctf.	42
Homestake	93
Inspiration Con	19
Miami Copper	26¼
Nat'nalLead,com.	58⅜
National Lead, pf.	107
Nev. Consol	21⅞
Pittsburg Coal, pf.	92
Ray Con	18⅞
Republic I.&S.com.	23¾
Republic I & S, pf.	78
SlossSheffi'd,com.	49
Sloss Sheffield, pf.	90
Tennessee Copper	45½
Utah Copper	62½
U. S. Steel, com	69⅝
U. S. Steel, pf.	110⅜
Va. Car. Chem	51½

N. Y. CURB May 28

Name of Comp.	Clg.
Barnes King	.30
Beaver Con	.46
Braden Copper	5½
B. C. Copper	5½
Buffalo Mines	‡1⅛
Caledonia	⅜
Con. Ariz. Sm	⅜
Davis-Daly	2
Diam'field-Daisy	14
Ely Con	⅛
Florence	1¾
Giroux	5⅜
Gold Hill Con	
Greene Cananea	9⅜
Greenwater	.07
Guggen. Exp	223
Internat. S. & R.	124
Kerr Lake	2⅜
Keystone	3
La Rose	3½
McKinley-Dar-Sa.	1⅛
Min. Co. of A. new	3
Motherlode Gold	⅛
Nev. Utah M. & S.	.05
Nipissing Mines	7¾
Ohio Copper	1⅛
Pacific Sm. & M	⅛
Ray Central	2⅜
South Live Oak	3½
South Utah M. & S.	⅜
Standard Oil (Old)	880
Stand'd Oil of N.J.	382
Stand'd Oil Subs.	490
Stewart	1⅜
Tonopah	7
Tonopah Ex	2
Tri-Bullion	⅜
Tularosa	⅛
Union Mines	⅛
United Cop., pfd.	10
Yukon Gold	3½

BOSTON EXCH. May 28

Name of Comp.	Clg.
Adventure	8¾
Ahmeek	320
Algomah	7
Allouez	44½
Am. Zinc	29
Ariz. Com., ctfs.	5¾
Bonanza	.40
Boston & Corbin	8½
Butte & Balak	4¾
Calumet & Ariz	76
Calumet & Hecla	490
Centennial	24
Con. Mercur	.05
Copper Range	58½
Daly West	5½
East Butte	13⅜
Franklin	12¼
Granby	54⅜
Hancock	34
Hedley Gold	17
Helvetia	‡13
Indiana	19¾
Island Cr'k, com.	54¾
Island Cr'k, pfd.	90
Isle Royale	28¼
Keweenaw	2
Lake	38¾
La Salle	6⅜
Mass	7¼
Michigan	3
Mohawk	63
New Arcadian	4¾
New Idria Quick	6¾
North Butte	29
North Lake	6¾
Ojibway	4½
Old Dominion	57¾
Osceola	119
Quincy	88
Shannon	15¼
Shattuck-Ariz	22
Superior	34
Superior & Bost.	2¾
Tamarack	42
Trinity	6¾
Tuolumne	3¾
U. S. Smelting	38½
U. S. Smelt'g, pf.	48¾
Utah Apex	2½
Utah Con	12¾
Victoria	4
Winona	6
Wolverine	109
Wyandot	2¼

BOSTON CURB May 28

Name of Comp.	Last
Bingham Mines	2
Boston Ely	1
Boswyocolo	.04
Butte Central	6
Cactus	.12
Calaveras	2
Chief Cons	1
Corbin	2
Cortez	1
Crown Reserve	3
First Nat. Cop.	2
Majestic	.52
Mazatan	‡ .60
Moneta Porc	‡ 11
Nevada-Douglas	4
New Baltic	3
Oneco	3
Raven Copper	35
Rhode Island Coal	35
San Antonio	‡3
S. W. Miami	8
South Lake	3
Trethewey	2
United Verde Ext.	.35
Vulture	‡5.00

COLO. SPRINGS May 28

Name of Comp.	Bid.
Acacia	.05
Cripple Cr'k Con.	.01
C. K. & N	.15
Doctor Jack Pot	.06
Elkton Con	.64
El Paso	.79
Findlay	.04
Gold Dollar	.17
Gold Sovereign	‡ .01
Isabella	.11
Jack Pot	.04
Jennie-Sample	.04
Lexington	‡ .01
Moon Anchor	.01
Old Gold	.03
Mary McKinney	.69
Pharmacist	.01
Portland	.88
Vindicator	.78
Work	.01

SALT LAKE May 28

Name of Comp.	Bid.
Beck Tunnel	.11
Black Jack	‡.18
Cedar Talisman	.02
Colorado Mining	.18
Columbus Con	‡.14
Crown Point	.03
Daly-Judge	‡6.35
Grand Central	.74
Iron Blossom	1.20
Little Bell	‡.40
Lower Mammoth	.02
Mason Valley	11.50
May Day	.08
Nevada Hills	1.95
New York	‡.04
Prince Con	1 52
Silver King Coal'n	2.27
Sioux Con	‡.05
Uncle Sam	.19
Yankee	‡.10

TORONTO May 28

Name of Comp.	Bid	Name of Comp.	Bid
Coniagas	‡6 90	Hollinger	10 75
Hudson Bay	‡70.00	Imperial	.03
Temiskaming	.39	Pearl-Lake	.16
Wettlaufer-Lor	.60	Porcu. Gold	‡.41
Apex	.03	Porcu. Tisdale	.01
Central	‡5 56	Preston E. D	.05
Crown Chartered	.16	Rea	.30
Dobie	.25	Standard	‡.04
Dome Exten	.33	Swastika	.18
Foley O'Brien	.20	West Dome	.16

LONDON May 29

Name of Com.	Clg.
Camp Bird	£1 9s 3d
Dolores	1 10 0
El Oro	0 17 0
Esperanza	1 10 0
Mexico Mines	7 0 0
Oroville	0 4 6
Stratton's Ind.	0 3 1½
Tomboy	1 3 9

‡Last quotation.